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LONG-TERM MANAGEMENT OF BAY OF BISCAY ANCHOVY (SGBRE-08-01)

San Sebastian, 2 - 6 June 2008

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SCIENTIFIC, TECHNICAL AND ECONOMIC COMMITTEE FOR FISHERIES (STECF)

STECF COMMENTS ON THE REPORT OF THE WORKING GROUP ON BALANCE BETWEEN RESOURCES AND THEIR EXPLOITATION (SGBRE)

LONG-TERM MANAGEMENT OF BAY OF BISCAY ANCHOVY (SGBRE-08-01)

SAN SEBASTIAN, 2- 6 JUNE 2008

STECF OPINION EXPRESSED DURING THE PLENARY MEETING OF 07-11 JUlLY 2008 IN HELSINKI

1. Background

The Commission intends to make a proposal for a long-term management plan for the anchovy based on the following objectives:

1. to ensure the exploitation of the stock at high yields consistent with maximum sustainable yield;
2. to guarantee the stability of the fishery, as far as possible, and with a low risk of stock collapse.

In 1999, the Commission entrusted STECF to produce an extended risk analysis showing, under different multi-annual management strategies, the consequences on the sustainability of the resource expressed in terms of risk of collapse and on the total annual yield. The evaluations included a test of robustness to a wide range of choices in the underlying biological parameters such as stock-recruitment relationships and fleet harvest behaviour models to simulate different responses of the fleet to resource availability.
In November 2007, the Commission has produced non-paper gathering different elements that should be considered and discussed with Member States, the scientific community and the SWW RAC. These should be thoroughly analysed before they are incorporate into the long-term plan.
Accordingly, two STECF Working Groups were convened, one in Hamburg from 14-18 April in parallel to the STECF/PLEN-08-01 meeting and a second in Pasajes from 2-6 June 2008. Both of these meetings addressed the following terms of reference.

2. Subgroup Assumptions

The working group evaluated the impact of three different harvest control rules (HCR) by simulation, regarding the sustainability of the stock, catches, economic balance and social impact.
Three different HCR were simulated. The first rule (Rule A) is based on catching a constant proportion (γ values) above an escapement Biomass (SSB) level. The second rule (Rule B) is based on catching a constant proportion (γ values) of the SSB. Thirdly a rule (Rule C) based on a constant short-term risk of 15% for low recruitment.
The performance of each rule was tested for γ values between 0 and 1 by steps of 0.1.

For each of the strategies outlined, the HCR with and without a ceiling equal to 33,000 tonnes, (the historically fixed level of TAC set to this fishery) and, with and without a minimum TAC as corresponding to the smallest catch that allows the fishery to remain economically viable (at 7,000 tonnes, as pointed out by the SWW RAC), were constructed.
In the fishery model, the simulation was performed using two operating models: an age-structured and a two-stage biomass fishery model.
The model was conditioned on the results from the stock assessment corresponding to ICES advice 2007. An age-structured model used for verification, is based on a seasonal multi-fleet integrated catch at age assessment as the one used in ICES 2005. This model was updated up to 2007 in order to provide starting conditions for the current simulations.
Catches were allocated to countries on a half-year basis. The allocation was based on the mean fraction of the catch taken by each Country during the period 1992-2004 (constant allocation). However, some other possible allocations were tested, 90% (Sp)-10% (Fr) to 60% (Sp)-40% (Fr). Furthermore a likely projection of the allocation of catches to countries is the draft under discussion at the pelagic committee of the Southern RAC (variable allocation relative to the TAC level).
The socio-economic impact was evaluated by means of algorithms developed during the meeting. It performs a stochastic socio-economic analysis considering the biological outcome as an input. It is based on estimations of production functions for anchovy by semester and by fleet, considering the SSB of anchovy, the number of vessels in the fishery of anchovy and the time devoted to it. A production function for the rest of target species was also estimated, in this case without considering any SSB.
A price function for anchovy, based on French and Spanish data is also estimated. Price for other species was considered as fixed.
The economic model was conditioned on the data provided by IEO & AZTI`s CAFE Project database (EU contract no 022644) for the Spanish fleets was used, and DPMA-IFREMER data for the French fleets. The time series goes from 2000-2005, and 2000-2006, respectively.
The indicators presented are:

- Biological risk measured in terms of number of the likelihood of SSB being below B_{lim}
- The number of years in which the fishery should be closed.
- The total expected match of anchovy.
- The variation of this catch.
- The Gross revenue obtained from anchovy (discounted 5%) for each fleet.
- Gross Cash Flow (discounted 5%) for each fleet.
- Economic risk as the likelihood of having a negative cash flow.
- A social indicator as the relative wage to the average of the country by FTE.

The report presents tables including the values obtained for all these indicators as well as a summary of the main findings and limitations. Tables showing the results of the various harvest strategies investigated are given in Tables 3.1.1.1 , 3.1.1.2, 3.1.1.2.1, 3.1.1.2.2, 3.1.3.1 of the SGBRE-08-01 Working Group report..

3. STECF Comments and Conclusions

STECF endorses the approach and findings presented in the report of the SGBRE-08-01 Working groups and draws the following conclusions:

1. The higher the exploitation rate the higher the catch, its variability, the associated biological risk and the discounted gross revenue.
2. The overall discounted cash flow is maximized for low harvest rates but this may be a consequence of the “optimistic” expected availability of other species and the assumption of a constant price. This could be also the reason for the relative low sensitivity to the allocation between member states.

3. Setting a maximum TAC of 33.000 tonnes reduces maximum attainable catch and decreases inter-annual variability in TACs and also reduces the associated biological risks. Furthermore, the economic risk is lower when a maximum is set.
4. Setting a minimum TAC of 7.000 tonnes does not alter mean catch or associated biological risk but increases the probability of closures.
5. For equivalent levels of biological risk, expected catches are higher for the options where there is no upper TAC constraint.
6. Both rules A & B imply similar biological risk at equal mean annual catch. However, Rule B may result in more stability in TACs.
7. The social indicator reflects the relationship between the average wage of the member state and those obtained by the fleets. STECF stresses that this indicator social only takes into consideration employment of on-board crew and in fact, only reflects the social consequences of a scenario that assumes a constant number of vessels.
8. The anchovy processing industry is asking for a well-supplied market (high TAC) and low prices. In that sense low TACs create a risk to the fleets of loosing their buyers. But high TACs also increase the risk of closing the fishery, and discontinuity in the supply could also result in the processing industry turning to other markets. The latter effect therefore provides a driver for TACs that give a low probability of closure. A survey to estimate recruitment strength takes place every autumn. If it can be demonstrated that the survey provides a reliable index of incoming recruitment, HCRs that make use of the index could be developed. A further evaluation process, which would include simulation testing, would then be required.
9. Results are insensitive to the choice of either the Ricker or the Quadratic Hockey stick stock and recruitment models. However, the results are highly sensitive to persistent low recruitment. Under such a scenario, the average catch would be less than 10,000 t while the associated biological risk will be higher than 10% for all HCRs investigated.
10. The economic data collected under the current DCR (even if it had been available), is not appropriate for conditioning the model used.

The model assumption that the total TAC will always be caught is probably unrealistic. It would be more appropriate to take into account the economic incentives for vessels to re-allocate effort between species. However, to solve this, a full feedback bio-economic model, which takes into account the economic behaviour of vessels and the biological consequences, is required. STECF notes that at present, such a model is unavailable.

STECF/SGBRE-08-01 WORKING GROUP REPORT ON

LONG-TERM MANAGEMENT OF BAY OF BISCAY ANCHOVY

San Sebastian, 2- 6 June 2008

This report does not necessarily reflect the view of the European Commission and in no way anticipates the Commission's future policy in this area

1. Introduction

The Commission intends to make a proposal for a long-term management plan for the anchovy. Two meetings took place in 2008 to provide the necessary scientific basis for a long-term management plan proposal for anchovy. The first meeting took place from 14-18 April in Hamburg and reported to STECF Spring plenary (Report STECF/SGBRE 0801). The group performed a thorough evaluation of two basic harvest control rules (HCR) and set the basis for an economic evaluation. Given paucity of data and shortage of time the economic evaluation performed was considered preliminary.

A second STECF group met in San Sebastian, Spain from 2 – 6 June, 2008. The group was tasked with the terms of reference (ToRs) outlined in the following section.

1.1. Statement of the Problem

1.1.1. The Anchovy stock in the Bay of Biscay

Anchovy (*Engraulis encrasicholus*) of the Bay of Biscay is a short-lived pelagic fish. The fishery is very important for both Spain and France. The stock experiences large inter-annual fluctuations in abundance caused mainly by variations in recruitment, driven by environmental factors. Recruitment has been very low since 2001. In particular, recruitment of the 2004 year class was classified as a failure. This has resulted in a decline of the stock and led to the closure of the fishery in the second half of 2005 and 2006. Since then the fishery has remained closed.

A more detailed description of the anchovy stock and the fishery was provided in the 1st STECF anchovy meeting (Report STECF/SGBRE 0801).

1.1.2. Reference points for management

Current biological reference points for the Bay of Biscay anchovy were defined by ICES ACFM in October 2003 as follows:

Table 1.1.1 Reference points for management

	Type	***Value***	***Technical basis***
Precautionary approach	B_{lim}	21 000 t	$\mathbf{B}_{lim}$: $\mathbf{B}_{loss}$ = 21 000 t (1989 SSB)
	B_{pa}	33 000 t	$\mathbf{B}_{pa} = \mathbf{B}_{loss} \times \exp(1.645\sigma)$
	F_{lim}	-	Not defined.
	F_{pa}	1.0–1.2	$\mathbf{F}_{pa}$: = F for 50% spawning potential ratio, i.e. the F at which the SSB/R is half of what it would have been in the absence of fishing.
Targets	F_y	-	Not defined.

(unchanged since 2003)

1.1.3. Management Objectives

There are no explicit agreed management objectives for this stock.
The present closure of the fishery aims at protecting the remaining stock until a strong year class recruits to the stock. The repeated recommendation of closures given by STECF since 2005 has implied in practice not allowing any catches until full recovery above B_{pa} is achieved.
The terms of reference of the current meeting state: The Commission intends to make a proposal for a long-term management plan for the anchovy based on the following objectives:

3. to ensure the exploitation of the stock at high yields consistent with maximum sustainable yield;
4. to guarantee the stability of the fishery, as far as possible, and with a low risk of stock collapse.

ICES advice on Management

ICES recommended that the fishery should remain closed in 2008 until reliable estimates of the 2008 SSB and 2007 year class, based on the results from the spring 2008 acoustic and DEPM surveys, became available. This implied a closure of the fishery until at least July 2008.

1.1.4. Approach taken by the ad hoc WG on Long-term advice on management (2nd meeting)

The STECF group met in AZTI San Sebastian on Monday 2nd June at 2pm. The group first examined the existing operating models: biomass-based and age-structured. The results from the HCR evaluation based on each model although following similar trends differ in associated risks. The reasons for the differences were investigated. Complete evaluation is conducted on the basis of the biomass-based model and the results from the age-structured model are presented for verification. In addition, sensitivity of the results to the different models' structure is analysed.

The economic analysis performed by the group used the data described in the 1st STECF meeting Report. In addition, French economic data and of social impact were collated and presented to this 2nd meeting. The economic models developed during the first meeting were further developed. A social indicator by fleet was constructed to compare the social implications of the HCR investigated.
A response to the STECF spring plenary questions was drafted and is presented in Annex 1.

1.2. Terms of Reference

The ToRs of the 1st meeting (April 2008) are still relevant to this one. Those are the following:

1. Having in mind the two basic objectives of the long-term management plan and the work produced in 1999, STECF is requested to provide an updated advice on the strategy to follow.

In case the new knowledge implies significant changes, recommend adaptations as appropriate.
2. Given a possible stock recovery under the long term proposal, for each Member State, what economic impacts (e.g. costs, revenues) can be expected considering the two scenarios described in Commission's non-paper:

a. strategy with relatively higher TAC levels but higher collapse risks,

b. strategy with relatively lower TAC levels and less frequent collapse risks.

- 7 -3. Given a possible stock recovery under the long term proposal, for each Member State, what social impacts (e.g. employment) can be expected considering the two scenarios described in Commission's non-paper:

a. strategy with relatively higher TAC levels but higher collapse risks,

b. strategy with relatively lower TAC levels and less frequent collapse risks.

Given the work already performed in the 1st meeting additional, more specific ToRs were proposed:
i) Perform the economic and social analyses on the basis of revised data which will include new data from France;

ii) Perform the economic and social analyses taking into account the biological uncertainty as resulting from the stochastic 10-year projections of the stock and fishery;

iii) Examine the sensitivity of the results from the HCR evaluation to alternative operating models.

1.3. Terms of reference (ToRs)

The terms of reference for this meeting were:

PART 1. SINGLE-SPECIES MANAGEMENT
(1) Determine a measure of fishing mortality corresponding to exploitation of the northern stocks of hake at maximum sustainable yield (=Fmsy).
(2) Establish by simulation the comparative benefits of gradually changing the current level of fishing mortality on northern hake to Fmsy in steps of (a) 5% per year (b) 10% per year (c) 15%per year.
(3) The exercise in paragraph 2 should be repeated for moving to Fmsy * 1.2 and Fmsy * 0.8.
(4) Measures of performance should be calculated including the mean, median, 25th. and 75th. percentiles of the following:

- Inter-year variability in (a) catches (b) TACs (c) discards
- Level of (d) annual catches (e) TACs
- Level of (f) fishing mortality
- Level of (g) SSB
- Level of (h) fishing effort (disaggregated by gear types as appropriate), in kW-days at sea needed to take the TAC.

and the annual risk of SSB falling under Bpa.
Measures should be calculated in comparison with setting TACs at a level corresponding to Fpa.

PART 2. MULTISPECIES MANAGEMENT
In parallel with the scenarios calculated in part 1, STECF is requested to calculate (for selected relevant scenarios, but including the strategy of moving to Fmsy in 10% annual changes) the effects on yields and stock sizes of the principal commercial species caught together with northern hake.

PART 3. OTHER SCENARIOS
STECF is invited to investigate on its own initiative other scenarios that may be comparable with the objectives of fishing a high and stable yield from the stock.

PART 4. ECONOMIC ANALYSIS
The simulations calculated here will at a later stage form the basis of an economic impact analysis. The implementing methods for this have not yet been developed.
(1) Identify the data needed for economic analysis purposes - fleets, aggregation, variables
(2) Ensure compatibility between "economic" and "biological" fleet segments
(3) Consider the application of the FLR programming approach (incorporating economic components)
(4) Identify problem areas/potential solutions in applying bio-economic modelling in impact assessment (using North Sea flatfish experience).

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2. Data and methods

2.1. Data

2.1.1. Anchovy landings

Volume of landings of Anchovy in the Bay of Biscay has followed a decreasing trend from 37 000 tonnes in 2000 to 16 000 tonnes in 2004. During the same period the price increased with the effect of a relative constant landing value of around 50 million Euros. Apart from in 2000 and 2001, the French pelagic trawlers and purse seines accounted for the biggest share of the landing value. The largest

difference is evident in 2003 in which the French landings amounted to 71 % of the total value of Anchovy.

Table 2.1.1. Anchovy landings and their value. Source: ICES. Average yearly prices

Year	2000	2001	2002	2003	2004
Spain					
Landings (tons)	19230	23052	6519	3002	7580
Value (1000 E)	30768	36883	19557	14109	23725
France					
Landings (tons)	17765	17097	10988	7593	8781
Value (1000 E)	28424	27355	32964	35687	27485
Total					
Landings (tons)	36995	40149	17507	10595	16361
Value (1000 E)	59192	64238	52521	49796	51210

The market for Anchovy is mainly concentrated in the Basque country. Even though the TAC is split between France and Spain approximately 95 % of the French landings are sold on the Basque market. The Basque market is therefore considered to be representative of the whole market for Anchovy.
The effect of decreasing volume of landings on the average price of Anchovy is clearly evident. In 2005 the collapse of the anchovy fishery determined the highest prices per kg (Figure 2.1.1).

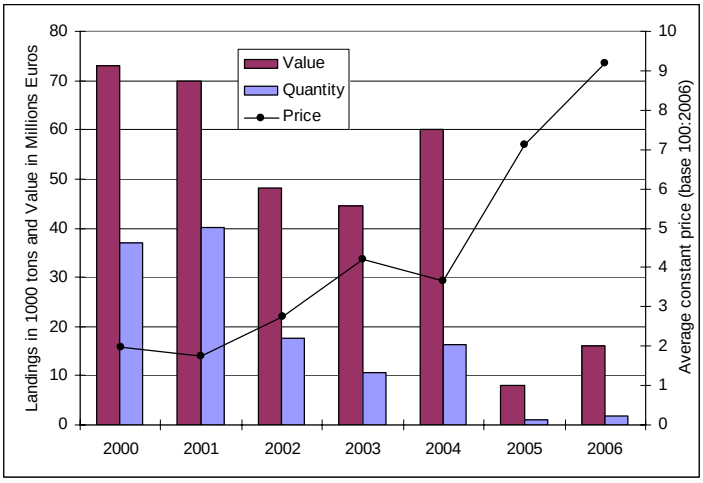


Figure 2.1.1. Anchovy landings in area VIII: quantity, constant value and price.

2.1.2. Fleet evolution and access regulation measures

France

The next figure presents the evolution of the number of vessels which harvest at least 1 tons of anchovy over the 2000-2004 period and the number of vessels eligible to the licence schemes at the end of 2007.

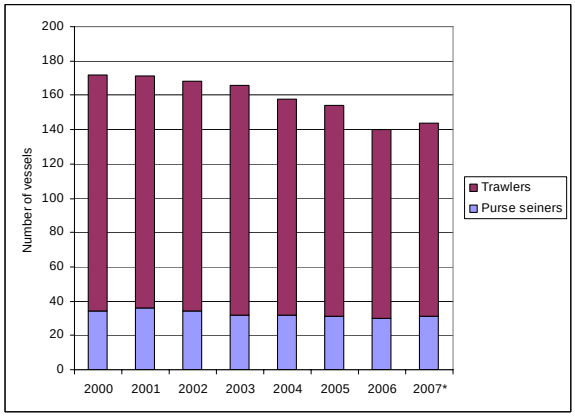
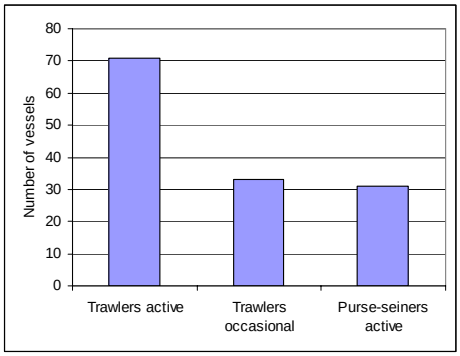


Fig 2.1.2.1 Evolution of the number of vessels per fleets in the Area VIII anchovy fishery

Note : vessels landing at least 1 ton of anchovy over the 2000-2004 * number of vessels in the license scheme at the end of 2007 Source : DPMA-IFREMER

The French anchovy fishery in ICES area VIII has been under license schemes since the end of 2007[1] and decommissioning schemes were implemented, especially in 2007 to reduce the size of the fleet. Three types of licenses defined by the gear used and the degree of historical activity in the fishery from 2000 to 2004 are considered. The gears for which licenses are allocated are purse-seine and trawl, the activity being defined as active or occasional. As a consequence, active purse-seine, active trawl and occasional trawl licenses were defined at the end of 2007 and the number of vessels operating under the licenses scheme is described in the following figure.



Source: DPMA

Fig. 6.1.2.2. Number of vessels operating under the anchovy licence scheme in 2007.

Maximum limits for the three types of licenses were established in terms of total kW and total GT. The average vessels technical characteristics for the three types of licences are presented in the table 2.1.2.1.

Table 2.1.2.1. Average technical characteristics per licence type (2007). Source : DPMA

	Trawlers active	Trawlers occasional	Purse-seiners active
Length (meters)	18.4	13.9	15.2
Engine power (kW)	322	229	199
Tonnage (GT)	86	36	36

The so-called occasional trawlers were not considered hereafter in the bio-economic analysis because the annual catches per year per vessel are restricted to a maximum of 20 tons and conditional to the

[1] Arrêté du 10 octobre 2007 portant création d'une licence pour la pêche professionnelle de l'anchois (Engraulis encrasicolus) dans la zone CIEM VIII. JOURNAL OFFICIEL DE LA RÉPUBLIQUE FRANÇAISE, 8 novembre 2007

anchovy quota available to them. According to the number of these vessels licensed (33), the maximum catches for occasional vessels are 660 tons and can be considered low compared to the potential catches of the other fleets.

Spain

The number of Vessels for Spain for the period 1987-2004 has been taken from the series available in the last ICES report about this fishery (ICES 2007), except for the year 2003, where a smaller number than those appearing in ICES was known to have taken place in the actual fishery that year (Table 2.1.2.2).

Time spent fishing anchovy

Estimation of the Spanish Fishing effort (number of days).

The Spanish fishery on anchovy takes place in spring and it is performed by purse seines coming from all the north of Spain from Galicia to the Basque country. As the fishery is mainly located at the South-eastern corner of the Bay of Biscay, the Basque Fishermen are usually the first to start the fishery, followed by Cantabric boats and finally joined (usually at the end of April by Galician boats). This dynamic process of increasing number of boats to the fishery from the beginning of April to May, when the maximum number of boats occur, and a gradual leaving off the fishery during June, as shown in Figure 2.1.2.3.

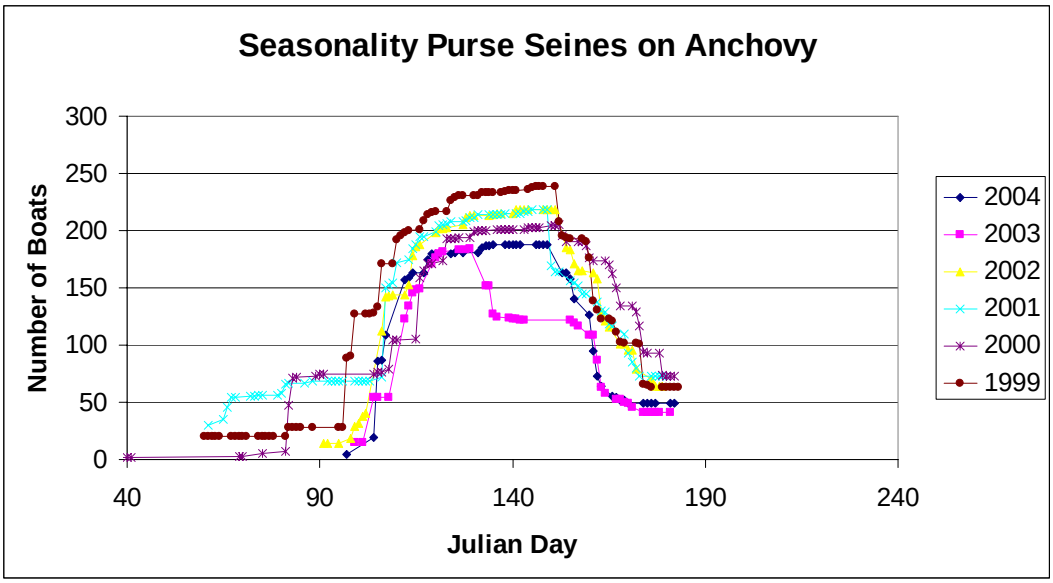


Figure 2.1.2.3: Number of different purse seine boats appearing in the sale records of Basque Country fishing ports by Julian day in recent years (AZTI sources).

For each year (1987-2004) the number of purse seiners participating in the spring fishery is known. Using the records of anchovy sales occurring in the Basque country ports (AZTI data) the recruitment and leaving process of boats to the anchovy was modelled by a double sigmoid curve.

Total daily trips was estimated as the product of the fishing boats targeting anchovy by fortnight (as function of the recruitment/leaving process modelled above) and the number of days devoted to anchovy fishing by fortnight. The latter is inferred as the total fishing days by fortnight for the period mid April and Mid June (when maximums catches occur for this fishery) or as the number of days by fortnight with significant catches of anchovy for the remaining period of the first half of the year

(significant catches meaning daily catches over 50 t in the Basque Country) (Uriarte pers. comm.). Total boats-day trips divided by the maximum total boats participating some time in the fishery sets the effective fishing days for the first half of the year. The table below specifies the input data by year:

Table 2.1.2.2: Spanish fleet involved in the Spring fishery for anchovy (Purse seiners) and fishing effort estimates according to the total number of boats*day operating in the first half of each year and equivalent fishing days (AZTI supplied data). Max effort is the maximum number of fishing days in the first half of the year and %effort is the fraction of time devoted to fishing anchovy by this fleet during the first half of the year.

Year	Fishing Effort Fleet	First half of the year Boat x Day	Effort (d.	Max Effort	% Effort to Anchovy
1987	282	8,630	30.6	90	34%
1988	278	9,404	33.8	90	38%
1989	215	7,099	33.0	90	37%
1990	266	9,126	34.3	90	38%
1991	250	8,608	34.4	90	38%
1992	245	7,509	30.6	90	34%
1993	253	10,000	39.5	90	44%
1994	257	10,409	40.5	90	45%
1995	257	10,611	41.3	90	46%
1996	251	8,799	35.1	90	39%
1997	267	10,910	40.9	90	45%
1998	266	10,715	40.3	90	45%
1999	250	10,378	41.5	90	46%
2000	235	9,068	38.6	90	43%
2001	220	8,934	40.6	90	45%
2002	215	7,900	36.7	90	41%
2003	194	7,151	36.9	90	41%
2004	201	7,453	37.1	90	41%

.

A similar approach was used for the second half of the year: But knowledge was reduced to a few years. From them it was deduced that the maximum number of purse seiners participating in the anchovy fishery during the second half of the year is about 45% of the number in the first half of the year. The division between the numbers of day x boat landings in the Basque Country between this numbers of maximum boats gave an average effort of days for the second half of the year, let fixed for the period of analysis of about 7 days.

2.1.3. Economic data

Spain

Spanish purse seiners

In spring, the economic value of the total landings of purse seines has been historically linked to anchovy landings, being anchovy the species with the highest economic value. A decreasing trend in total landings value can be seen in the period 2000-2005 (Figure 2.1.3.1). In 2005 the collapse of the anchovy fishery determined the lowest value of landings.

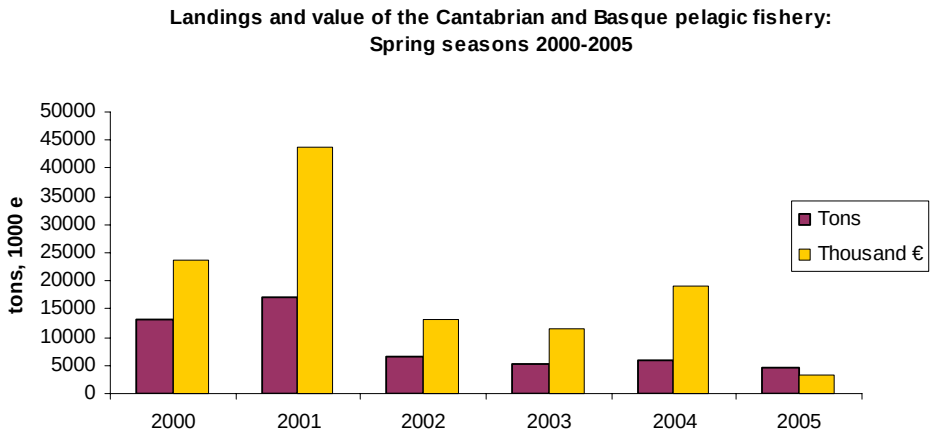


Figure 2.1.3.1. Historical evolution of total landings and value of landings. Data comprises landings from Cantabrian and Basque purse seines in spring seasons of the period 2000-2005. Source: IEO & AZTI`s CAFE Project database (EU contract no 022644).

France

Economic data sets were required to estimate parameters of the economic model. Data used were; annual income and costs per vessel for a sample of the fleets studied, vessels landings (value, quantity for anchovy and other species) for the fleet population by six-month period and annual, effort estimation by half of the year and annual.

Evolution the gross revenue and gross revenue per species for a panel of licensed vessels

Panels, defined as constant sets of vessels operating each year from 2000 to 2006 in the anchovy fishery were followed taking into consideration their average degree of dependence of vessels on anchovy. The degree of dependence per vessel or pairs of vessel (for the pelagic trawlers) was defined here, as the percentage of anchovy gross revenues in the total gross revenues over the 2000-2004 periods. Two categories of vessels were followed according to the gear used to harvest anchovy and their length size. These two categories are covering boats that actively harvest anchovy (see the licence system description). 19 and 66 vessels belonging to the active purse-seiners and trawlers fleets were selected which respectively represents 61% and 93% of the active licensed vessels for the given defined categories in 2007. This panel respectively lands 66% and 93% of the anchovy total landings per categories over the 2000-2004 period. As shown on the following figure, the total of the landings of these two categories represents between 72% and 82% of the French landings.

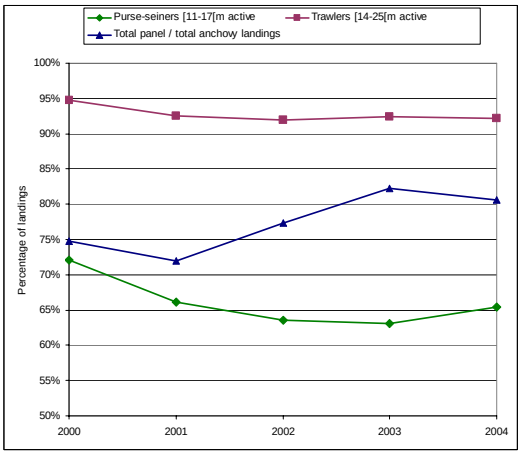
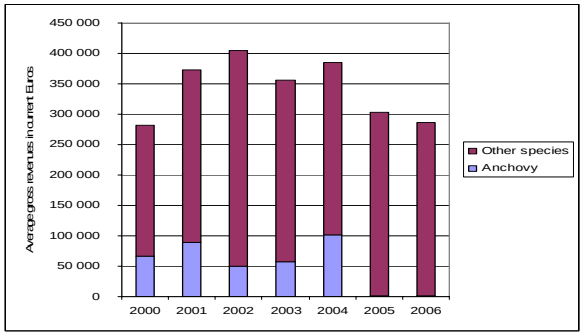


Figure 2.1.3.2. Percentage of panel landings and fleet landings relative to the total French anchovy landings. Source : DPMA-IFREMER

The following graphs present the catches of anchovy compared to the total catches for both fleets. The different degrees of dependence on anchovy are here aggregated. The main trend is a decrease in the total gross revenues for pelagic trawlers and purse seiners from 2002. A part of this decrease is due to the very low level of gross revenues made on anchovy (no catches for the purse seiners from 2004). This graph shows that in average in the fleets, the loss of gross revenues due to the anchovy closure are partially covered by a raise of the gross revenues made on the other species, which may traduce a report of the effort on other species.

French Purse-seiners [11-17[m active: evolution of the average gross revenues per vessel and per species



French trawlers [14-25[m active: evolution of the gross revenues per vessel and per species

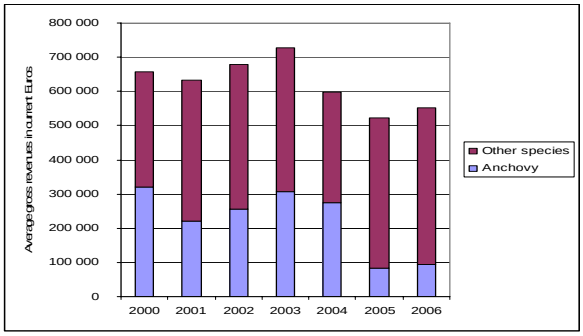
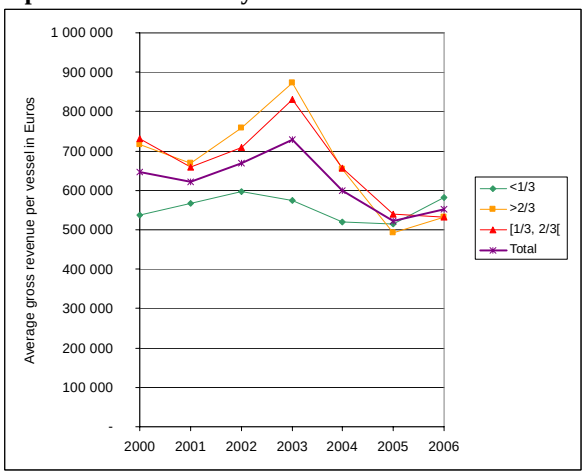


Fig. 2.1.3.3. French fleet, evolution of the gross revenues. Note: panel data 2000-2006. Source: DPMA-IFREMER

The next figure presents the evolution of average gross revenues per vessel in current euros and index (base 100: 2000), with the dependence on anchovy expressed in shares of the gross revenue (<1/3, [1/3-2/3[, >2/3, respectively). This degree of dependence can be used to model the variability of the fleets and to check more precisely the impact of the closure depending on the past activities of the fleets. For the active French trawlers with a dependence on anchovy representing more than 1/3 of the landings in value, the reduction in gross revenues in 2005 and 2006 compared to 2000 is around 25%. . The decrease in value is more significant while comparing to 2003 and raise up to 40%. For vessels with a dependence on anchovy representing less than 1/3, the gross revenues did not decreased over the 2005-2006 period. The gross revenue tends to be homogenized for the whole fleet in 2005 and 2006 with a decrease of the vessel highly dependent on anchovy. The total decrease is around 15% compared to 2000 and 25% while comparing to 2003.

French trawlers [14-25[m active: evolution of the average gross revenues per vessel and per degree of dependence on anchovy



French trawlers [14-25[m active: : Index evolution of the average gross revenues per vessel and per degree of dependence on anchovy

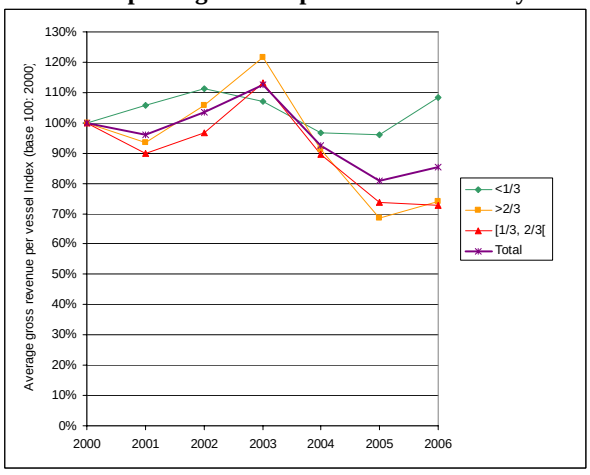


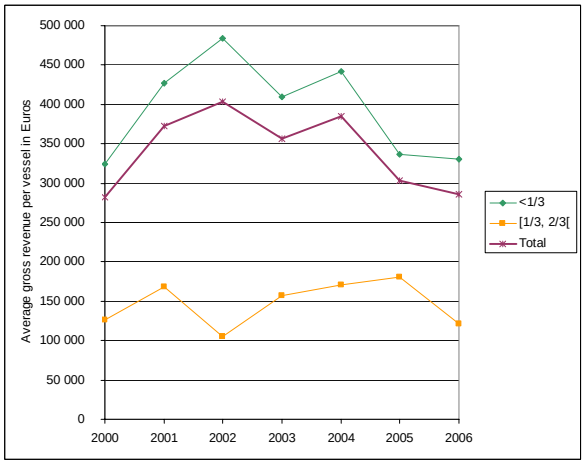
Figure 2.1.3.4. French trawlers [14-25] m active.

Notes: panel data 2000-2006, (<1/3, [1/3-2/3[, >2/3), degree of dependence expressed as the share of anchovy gross revenue in total gross revenue over the 2000-2004 period Source: DPMA-IFREMER

For French Purse seiners, no boat was dependent on anchovy at a level higher than 2/3 of the total gross revenues on the period 2000-2004. The mean gross revenues per boats are quite different depending on the degree of dependence on anchovy that is due to a distinction in the fleets of vessels operating in the Basque fishery in the first part of the year and a southern Brittany fishery mainly in the second half of the year. A decrease in mean gross revenues can be identified between the period 2002 and 2006 but looking at the index (base: 2000), none of these categories faced a critical drop in gross revenues after the anchovy closure compared to 2000. The drop is significant in 2005 and 2006 compared to the period 2002-2004, especially for the <1/3 dependant vessels.

French Purse-seiners [11-17[m active: evolution of the average gross revenues per vessel and per degree of dependence on anchovy

French Purse-seiners [11-17[m active: Index evolution of the average gross revenues per vessel and per degree of dependence on anchovy

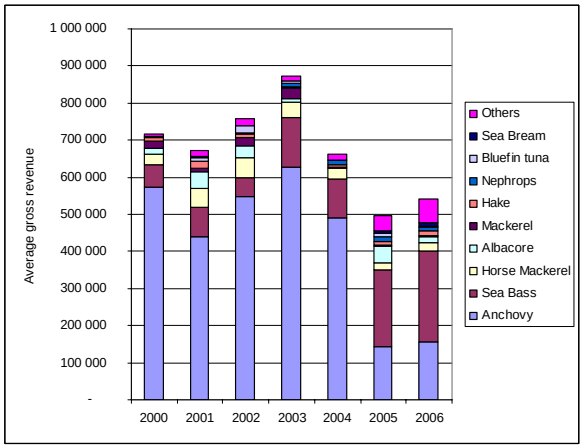


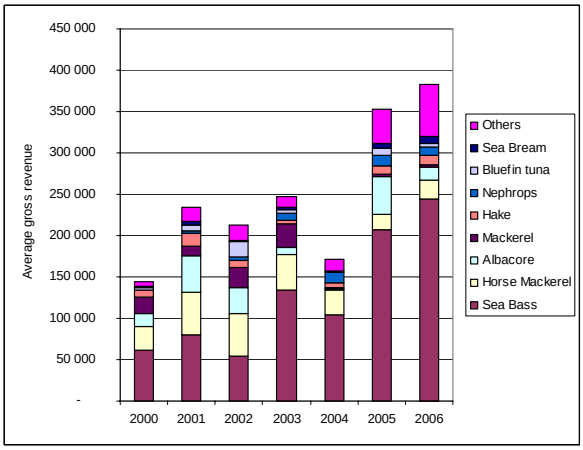
Notes: panel data 2000-2006, (<1/3, [1/3-2/3[, >2/3), degree of dependence expressed as the share of anchovy gross revenue in total gross revenue over the 2000-2004 period
Source: DPMA-IFREMER
Fig. 2.1.3.5. French purse-seines.

Landings composition evolution expressed in terms of gross revenue for the most important species is provided in the next figures according to fleets and degree of dependence to anchovy. The most dependant trawlers fleets partially compensated the decline in anchovy landings by a significant increase in sea bass landings and to a less extent by albacore and other species. The same trends on sea bass can be seen for the less dependant vessels (<1/3 of anchovy landings over the 2000-2004 period). For the purse-seiners, especially the less dependant vessels, the targeting of other species is less evident as no significant increase in other species landings is identified.

Evolution of average gross revenue per species: French trawlers [14-25[m active, degree of dependence to anchovy >1/3

Evolution of average gross revenue per species anchovy excluded: French trawlers [14-25[m active, degree of dependence to anchovy >1/3

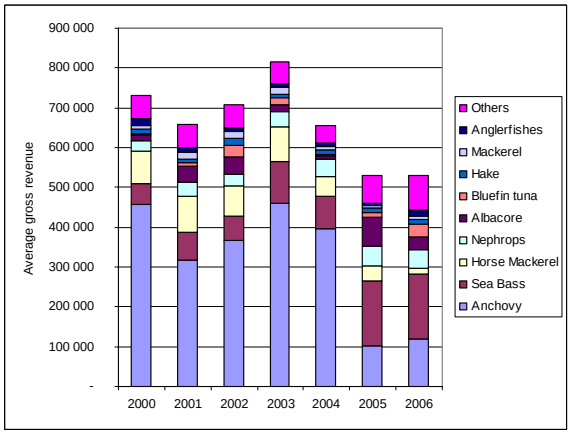


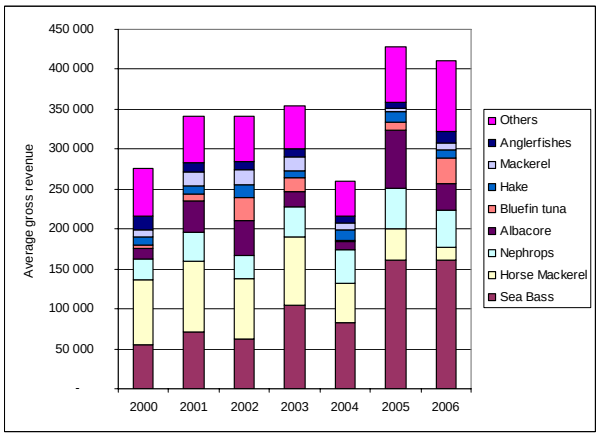


Source: DPMA-IFREMER

Evolution of average gross revenue per species: French trawlers [14-25[m active, degree of dependence to anchovy [1/3-2/3]

Evolution of average gross revenue per species anchovy excluded: French trawlers [14-25[m active, degree of dependence to anchovy [1/3-2/3]

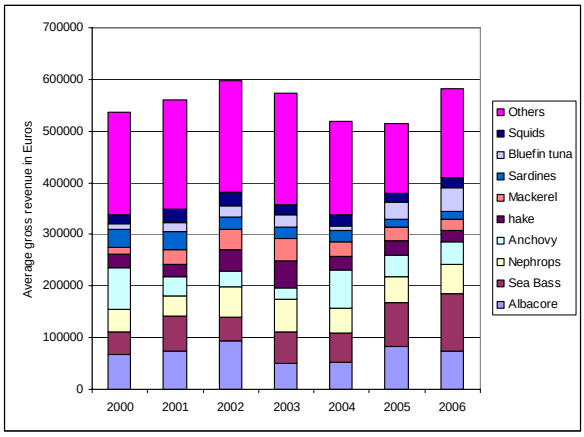


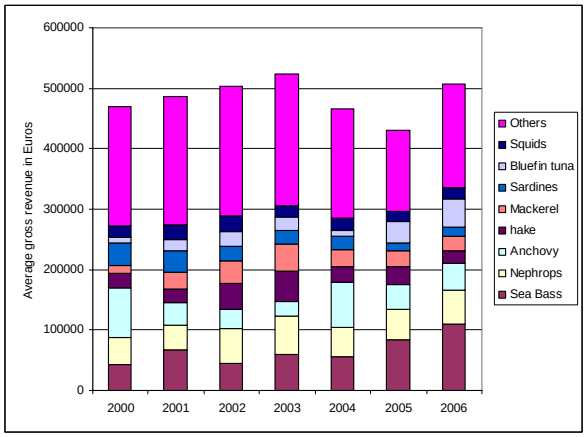


Source: DPMA-IFREMER

Evolution of average gross revenue per species: French trawlers [14-25[m active, degree of dependence to anchovy [1/3-2/3]

Evolution of average gross revenue per species anchovy excluded: French trawlers [14-25[m active, degree of dependence to anchovy [1/3-2/3]

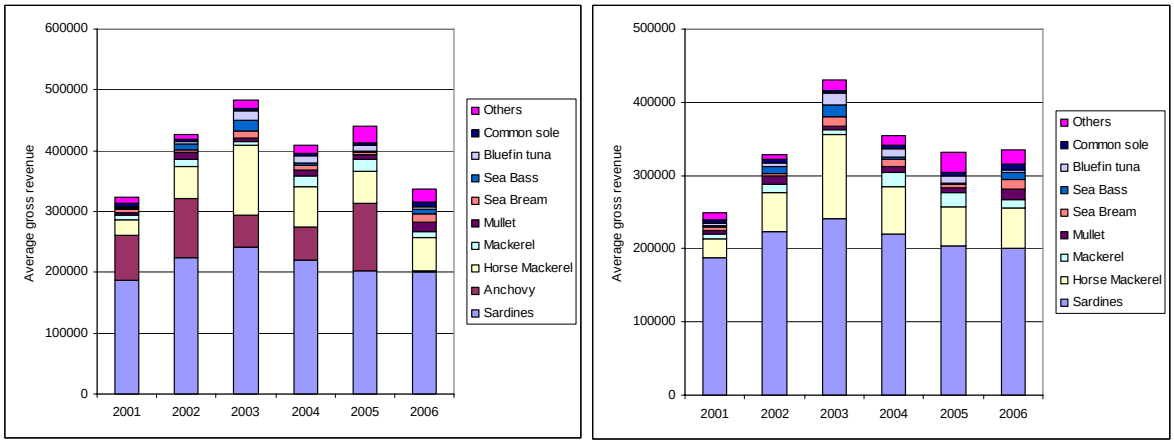




Source: DPMA-IFREMER

Evolution of average gross revenue per species: French Purse-seiners [11-17[m active, degree of dependence to anchovy <1/3

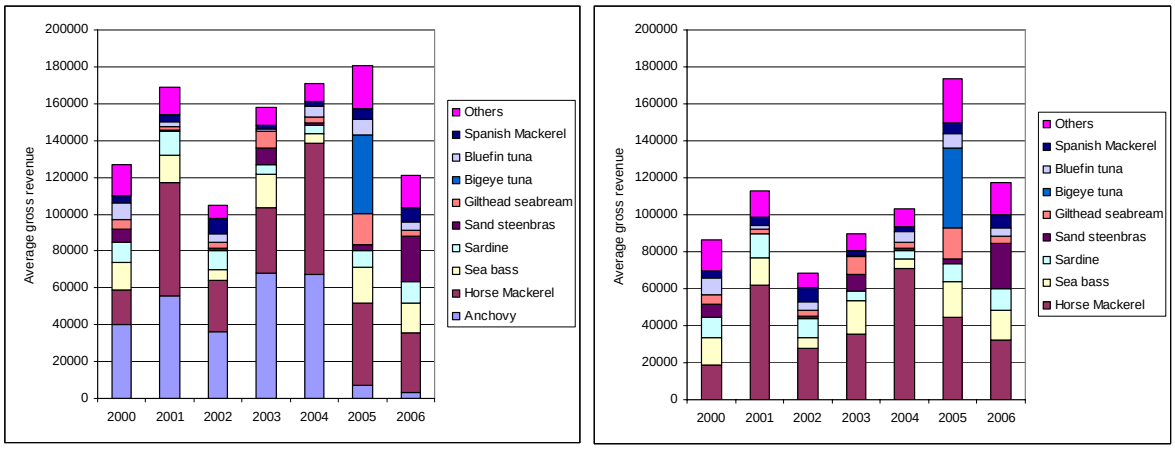
Evolution of average gross revenue per species anchovy excluded: French Purse-seiners [11-17[m active, degree of dependence to anchovy <1/3



Source: DPMA-IFREMER

Evolution of average gross revenue per species: French Purse-seiners [11-17[m active, degree of dependence to anchovy [1/3-2/3]

Evolution of average gross revenue per species anchovy excluded: French Purse-seiners [11-17[m active, degree of dependence to anchovy [1/3-2/3]



Source: DPMA-IFREMER

Income and costs

A sub-sample of vessels operating in the anchovy fishery was selected from the economic sample collected under the Data Collection Regulation (DCR) for the period 2002-2006. The sub-sample selection was done in the anchovy fleet population defined under the licence scheme described previously. In the license scheme established in 2007, three fleets were identified; active purse-seiners, active trawlers and occasional trawlers. The sample selection in the previous years, from 2002 to 2006, was carried out using the licence fleet stratification conditioned to the rule that individual vessel anchovy landings be larger than 1 tons per given year.

The next tables present the size of the sample, the population and the sampling rate for the two selected fleets. The length categories [11-17[m and [14-25[m refers to the lower and upper lengths limits of each sample and do not refer to management limits.

Table 2.1.3.1. Sample, population size in number of vessels and the sampling rate for the two selected fleets.

Sample

Segment	2002	2003	2004	2005	2006
Purse seiners [11-17[m active	13	12	11	3	2
Trawlers [14-25[m active	8	15	16	17	21
Total	21	27	27	20	23

Population

Segment	2002	2003	2004	2005	2006
Purse seiners [11-17[m active	31	29	29	8	3
Trawlers [14-25[m active	45	50	54	51	48
Total	76	79	83	59	51

Sampling rate

Segment	2002	2003	2004	2005	2006
Purse seiners [11-17[m active	42%	41%	38%	38%	67%
Trawlers [14-25[m active	18%	30%	30%	33%	44%
Total	28%	34%	33%	34%	45%

Source: DPMA

Economic indicators calculation is based on the recommendations of the STECF Sub-Group Economic Affairs (SGECA). The following indicators were calculated at a more detailed level than required in the current DCR in order to be used into the economic model. Average and standard deviation figures are provided in the table except for the purse-seine fleet in 2005 and 2006 due to statistical constraints on the size of the sample.

Table 2.1.3.2. Economic sample: Indicators in terms of average and standard deviation for the main French anchovy fleets: purse-seiners [11-17[m active and trawlers [14-25[m active (2000-2006 in current Euros).

Purse-seiners [11-17[m active

Average in Euros (sample)	2 002	2 003	2 004	2 005	2 006
INCOME	316	403	529		
FUELCOST	11	13	17		
CREWCOST	160	199	259		
REPCOST	22	28	32		
OTHERCOST	58	87	101		
OTHERCOST	58	87	101		
VARCOST	27	37	42		
NVARCOST	31	50	59		
VARCOST	27	37	42		
LANDINGCOST	18	28	30		
FTE	5.5	5.8	6.5		

Standard deviation (sample)	2 002	2 003	2 004	2 005	2 006
INCOME	189	215	205		
FUELCOST	5	5	6		
CREWCOST	90	95	101		
REPCOST	21	20	19		
OTHERCOST	25	57	38		
OTHERCOST	25	57	38		
VARCOST	15	26	13		
NVARCOST	11	32	26		
VARCOST	15	26	13		
LANDINGCOST	10	21	12		
FTE	1.5	1.3	1.3		

Trawlers [14-25[m active

Average in Euros (sample)	2 002	2 003	2 004	2 005	2 006
INCOME	677	706	543	589	632
FUELCOST	81	97	90	100	108
CREWCOST	291	290	211	227	243
REPCOST	79	51	58	50	52
OTHERCOST	94	119	115	132	134
OTHERCOST	94	119	115	132	134
VARCOST	44	53	51	58	59
NVARCOST	50	66	64	74	75
VARCOST	44	53	51	58	59
LANDINGCOST	29	35	32	38	38
FTE	5.8	5.6	5.4	5.7	5.5

Standard deviation (sample)	2 002	2 003	2 004	2 005	2 006
INCOME	189	222	163	167	221
FUELCOST	27	29	30	30	36
CREWCOST	100	98	67	76	92
REPCOST	39	33	33	38	30
OTHERCOST	16	45	45	45	66
OTHERCOST	16	45	45	45	66
VARCOST	7	19	17	18	30
NVARCOST	9	28	30	29	40
VARCOST	7	19	17	18	30
LANDINGCOST	5	13	11	13	20
FTE	0.9	1.4	1.3	0.9	1.1

Source : DPMA according to DCR regulation

Indicators presented in the previous table include the income defined as the gross revenues from harvesting and other sources of income which are negligible for the vessels studied. Crew cost includes the net wages for crew member but also the social security cost paid by the crew member and the vessel owner. For the economic model, other costs were split in non variable costs and variable costs. In variable costs, landings costs are identified. Nor depreciation costs neither interest costs were considered in the analysis.

2.2. Stock and Fishery Model

2.2.1. Stock Dynamics

The stock dynamics was explained in detail in the Report from the 1st STECF meeting operating model which consists of a stock, a fishery model and an observation model. The dynamics of the stock and the fishery were modelled on the basis of a biomass model (see section 6.2.1.1 for detail) and an age-structured model (section 2.2.1.2).

2.2.1.1. Biomass model

The stock dynamics is modelled on the basis of the biomass of two age-groups: the 1-year-old and the 2-plus which comprised fish of age 2 and older. Natural mortality and growth is encompassed in the parameter *g*. A description of the population model and the model conditioning is in Section 2.1 of the Report from the 1st STECF meeting.

2.2.1.2. Age-structured model

An age-structured operating model using an FLR framework was implemented to verify the results from the biomass model and to test the sensitivity of the results to a different model structure. This model was based on a seasonal multi-fleet integrated catch at age assessment (MFICA) as the one used in ICES 2005. Consists of 4 age-groups where the dynamics is introduced by natural (M) and fishing mortality (F). While M is constant across ages and time, F is separable on a half year basis and can be expressed as the product of the fishing mortality ($F_{y,s}$), where *y* corresponds to year and *s* to either the first of 2nd half of the year, and selectivity at age S_a. A full description of the population model and the model conditioning is in Section 2.1 of the Report from the 1st STECF meeting.

2.2.1.3. Stock and recruitment model

A number of models were compared (Report STECF/SGBRE 0801) and the analysis indicated the use of a Ricker and a quadratic hockey-stick in the operating models. However, results suggested little sensitivity to the choice of model. Therefore, given paucity of time some of the scenarios tested were based on the Ricker model only.

A third scenario of persistent low recruitment was considered for testing. In this case recruitment was drawn randomly from a normal distribution with mean = 19 000 tons and standard deviation = 9 200 tons (ICES 2007).

2.2.1.4. Selectivity and catchability models

Selectivity of the fishery is assumed flat in the biomass model while the age-structured model uses selectivity at age parameterised in the MFICA. The features of the models are fully explained in the Report STECF/SGBRE 0801.

2.2.1.5. Allocation of catches by six-month periods and countries

The allocation of catches between countries and to the 1st or 2nd half of the year is performed as illustrated in Figure 2.2.1.5. First, the TAC is allocated between countries and then the catch per country is allocated to six-month periods (From 1st January to 30th June and from 1st July to 31st December).

Two options were explored for the country allocation:

(a) historical allocation computed as the average of the past series

(b) variable allocation depending on the TAC (see Report STECF/SGBRE 0801 for a full description).

Similarly, two schemes were considered for the country allocation by half of the year:

(A) historical allocation for both countries

(B) intermediate allocation for France computed as the average between the historical allocation and the one that would result if the French winter fishery disappears (see annex see Annex II of the Report STECF/SGBRE 0801 for a full description).

In this report the same allocation schemes as the ones used in the 1st STECF meeting have been used:

(1) Constant TAC allocation: Both the allocation by countries and the country allocation by half of the year are done according to the historical series (cases a and A).
(2) Variable TAC allocation. The allocation by countries is variable (case b) and the country allocation by half of the year is intermediate for France (case B)

In addition, in order to study the sensitivity of the results to the country allocation, additional simulations were performed where the allocation by country ranged from 50 to 50% to 90% Spain to 10% France in steps of 10%. The country allocation by half of the year was intermediate according to the scheme B.

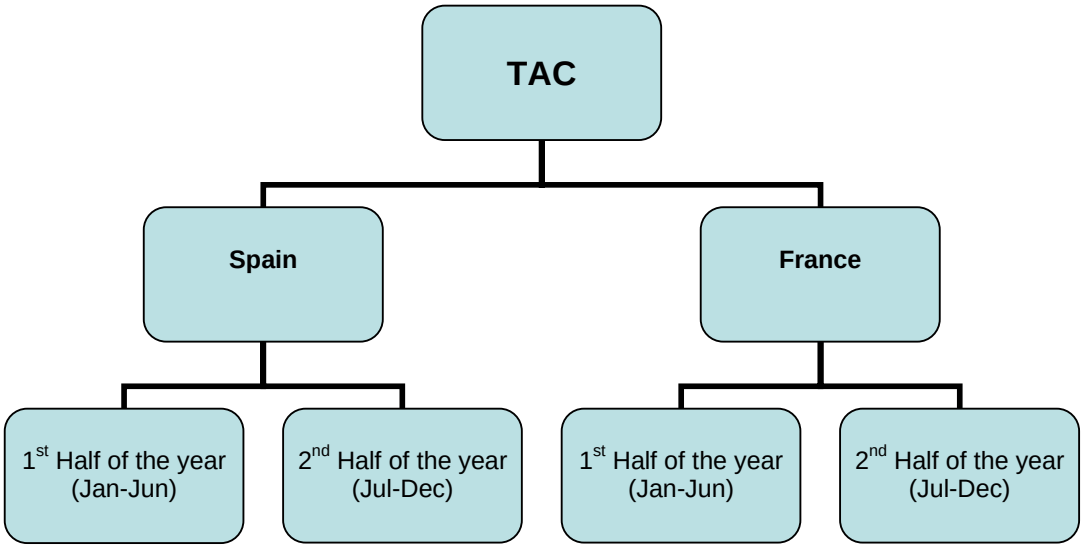


Figure 2.2.1.5: Diagram representing the annual TAC allocation process by Country and Half of the year

2.3. Economic model

The group attempted a socioeconomic evaluation of different management strategies. For doing so, results obtained from the biological side were analyzed in terms of the overall performance of the fishery, as well as the performance of each of the fleets involved in it.

The economic analysis is based on the catchability coefficients per half of the year derived from the estimation of the production functions for each of the fleets involved in the anchovy fishery and the estimation of a demand function for the overall fishery. Since the fleets are also involved in other target species, an overall production function and a price model for other species have also been incorporated for each of the fleets. The main economic indicators included in the simulation model are the gross revenues and the cash flow by fleets, which has been derived based on the standard income sharing remuneration system and other related fix and variable costs such as landing fees, fuel, bait, ice and gear costs. The fishermen wages have been used as the social indicator to simulate the future performance of the fishery. This indicator permits to compare the average wage derived from the fishing activity and the average wage of any other economic sectors. Thus, it may be considered as a proxy for the social welfare surrounding the fleets participating in the anchovy fishery.

a) Production function for anchovy

The production model is based on 6 restricted ($\alpha=\beta=\delta=1$)[2] standard Cobb Douglas production functions, which have been estimated by half year and fleet for the periods 1987-2004 (in the case of Spanish purse seines) and 2000-2004 (for French seines and trawlers) on the basis of the following functional form (1):

$$Y_{ais} = q_{ais} \cdot SSB_{ais}^{\alpha s} \cdot NB_{ais}^{\beta s} \cdot E_{ais}^{\delta s} \qquad (1)$$

The subscript s =(1,2) stands for six-month period January - June (half of the year 1) and July-December (half of the year 2), t for the year, i the fleet and a for the anchovy fishery. Catchability (q) corresponds to the fraction of the fish stock which is caught by a defined unit of the fishing effort, NB is the number of vessels, SSB the spawning stock biomass and, finally, E_{ais} corresponds to the time spent by the fleet (i) in the anchovy fishery (a) in half year s. The estimated catchability coefficients, the related standard errors and adjusted R^2 are shown is Table 6.3.1.

Table 2.3.1: Estimated catchability parameters per fleet (i) and half year (s).

Fleet	Parameter	Value	Std. error	R^2
i=SPS_1	q_{ai1}	0.0024	0.0001	0.89
i=SPS_2	q_{ai2}	0.0038	0.0007	0.59
i=$FPSS_1$	q_{ai1}	0.0008	0.0004	0.39
i=$FPSS_2$	q_{ai2}	0.0050	0.0012	077
i=FPT_1	q_{ai1}	0.0026	0.0008	0.62
i=FPT_2	q_{ai1}	0.0083	0.0011	0.91

(Spanish purse-seiners), FPS (French purse-seiners) and FPT (French trawlers).

a.1) Time spent in the anchovy fishery

Since the vessels operating in the anchovy fishery have also another target species the time spent in the anchovy fishery has to be imputed. In order to do so and based on definitions (2) and (3), equation 4 has been used, which stands that the time spent in anchovy fishery is the minimum derived from production technology in order to catch the quota in each half year.

Notice that the maximum level of nominal effort spent at sea $\overline{E_{is}}$ by fleet i in half year s is defined by equation (2):

$$\overline{E_{is}} = E_{aits} + E_{oits} \qquad (2)$$

where, E_{aits} is the nominal effort spent by fleet i in anchovy fishery and E_{oits} is the nominal effort spent by fleet i in other fisheries.

Following that:

$$\overline{E_{it}} = E_{ait1} + E_{ait2} + E_{oit1} + E_{oit2} \qquad (3)$$

[2] Due to the lack of degrees of freedom for the French fleets, the production elasticity of the catches for SSB, NB and E, that is, (α, β, δ) are assumed to be equal to 1.

$$E_{aits} = \min\left(\overline{E}_{is}, \left(\frac{Quota_{aits}}{q_{ais} \cdot SSB_{aits}^{\alpha} \cdot NB_{aits}^{\beta}}\right)^{\frac{1}{\delta}}\right) \text{ for } s=1,2 \qquad (4)$$

Since the TAC is divided for Spain and France,

$$Quota_{France} = TAC - Quota_{Spain}$$

Furthermore, taking into account that France has two different fleets, purse seine fleet (PS) and pelagic trawler fleet (PT) the derived quotas will be:

$$Quota_{PS} = Share_{PS} * Quota_{France} \qquad (5a)$$

$$Quota_{PT} = (1 - Share_{PS}) * Quota_{France} \qquad (5b)$$

b.1) Production Function for other species

A set of simplified production functions for the landings of other species by each of the two half years have been estimated (6) for each of the fleets under the assumption that production elasticities are equal to 1 (i.e. β=δ=1). Notice also that (6) implies that there is no biomass effect in the function for the landings of the other species. As shown in Table 2.3.2, all the estimated coefficients (k_{ois}) are significant at usual significance levels and are correctly assigned.

$$Y_{oits} = k_{ois} \cdot NB_{aits}^{\beta} \cdot E_{oits}^{\delta} \text{ for } s=1,2 \qquad (6)$$

where $k_{ois} \sim N(mean_{K_{ois}}, \theta_{K_{ois}})$, and E_{oits} comes from (2)

Table 2.3.2: Estimated k parameters per fleet (i) and half of the year (s)

$Fleet_s$	Parameter	Value	Std. error	R^2
i=SPS	k_{ai1}	253.1	35.03	0.96
$i=FPS_1$	k_{ai1}	281.7	9.2	0.99
$i=FPS_2$	k_{ai2}	704.4	49.2	0.97
$i=FPT_1$	k_{ai1}	271.2	15.99	0.98
$i=FPT_2$	k_{ai1}	293.8	20.1	0.97

Notice that for the Spanish purse seines (SPS) only a yield by year function is estimated (this may imply an over estimation of the gross revenue), while for the French fleets (i.e. FPS, FPL) the other species production function is by half year. This has important implications for the simulation model.

c) Price functions

c.1. Price function for anchovy

Two data sets have been merged (i.e. Basque and French total anchovy landings from the auction market in the Atlantic harbours) in order to calculate an average half year first sale price for the landings coming from area VIII. The total landings represent 85% to 99% of the total landings according to ICES report. Constant prices (€2006) per half year and total landings from ICES report have been used in the estimations. Two alternative demand models have been checked and estimated from data for the period 2000-2006: (Model 1) A semi-log price (P) model including 2 independent variables (i.e total anchovy landings (Y) (7), and half year (SEM) and; (Model 2) a semi-log restricted one, only including landings (7'). A priori Y is expected to influence negatively on prices. SEM is a dummy, taking value 1 for the landings done in the first half year of the year. The variable SEM may be in fact capturing gear, size and quality effects. In the second half of the year the fishery is mainly exploited by pelagic trawlers and according to the species characteristics, anchovies are smaller and they have more fat content, which is less valued by the canning industry. Accordingly SEM is expected to positively influence on prices.

$$P_{ast} = a + b * (Log(Y_{ast})) + c * SEM_{ast} \quad (7)$$

$$P_{ast} = a + b * (Log(Y_{ast})) \quad (7')$$

All the coefficients are significant at usual levels, have the expected sign and the have an adequate overall fit (Table 2.3.3). Regarding the sign of the parameters, the estimated effect for the volume of landings is negative and anchovies landed in the first half of the year reach higher prices. The F test in order to discriminate between the two models (F=3.68, p=0.08) stands that there exists statistical evidence in favour of model 1, although the degree of significance in not clearly determinant.

Table 2.3.3. Estimated parameters for the demand function

	Fleet	Value	Std. error	R^2	F
Model 1	a	22.37	2.7417	0.85	32.56
	b	-2.15	0.2963	-	-
	c	1.05	0.0041	-	-
Model 2	a	24.07	2.9211	0.81	48.77
	b	-2.27	0.3259	-	-

The price models performance is shown below:

Model 1

The estimated prices for a theoretical TAC using model 1 are shown in the following graph:

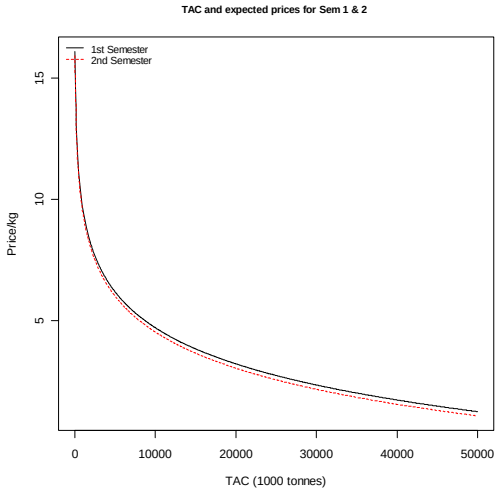


Figure 2.3.1. Estimated prices using model 1

And the corresponding value of the TAC will be

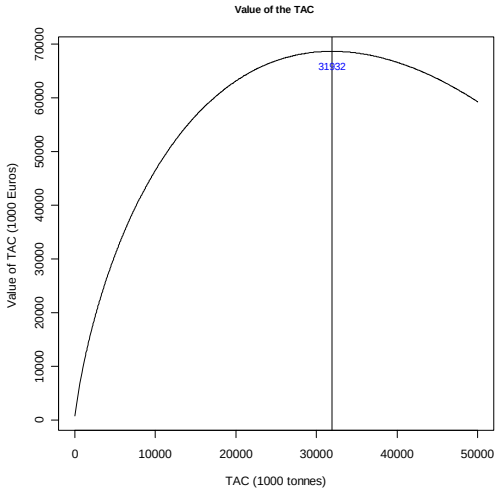


Figure 6.3.2. Value of the TAC using model 1.

Where the maximum value is obtained at a TAC level of 32000 tonnes.

Model 2

The estimated prices for a theoretical TAC using model 2 are shown in the following graph:

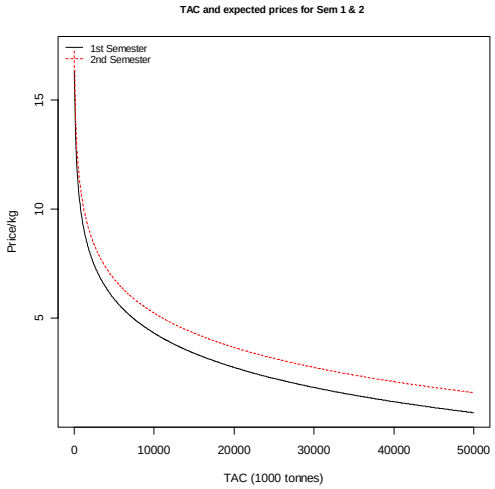


Figure 2.3.3. Estimated prices using model 2

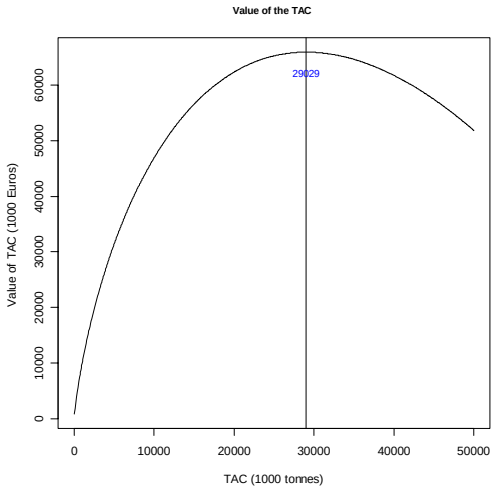


Figure 2.3.4. Value of the TAC using model 2, where the maximum value is obtained at a TAC level of 29000 tonnes. Note that in model 2 the price function is higher for 2nd half of the year. This is because the 0.6-0.4 allocation for first and second half of the year was used. Then, the lower the landings the higher the price which overshoots the first half of the year fixed effect.

Giving that model 1 has a higher R^2 and based on the results from the F-test which discriminates between the two models and favours model 1 ($F=3.68$, $p = 0.08$), we have selected this model for running the simulation. In any case further research should be made on this basis, in order to check if the price function shape is what we have assumed and also to check if both countries differ in their price formation.

c.2. Price for others species

The price of other species (P_{oi}) is assumed fixed, although different for each fleets involved in the fishery. Note that for the French fleets each P_{oi} was estimated by half year, while in the case of Spanish seiners was done annually. Prices for other species were calculated as an average for the period 2000-2004 (constant € 2006) as follows:

$$P_{oi} = (ROL–RAL)/(OL–LA)$$

Where *ROL* is the revenue related to overall landings, *RAL* is the specific revenue from anchovy, *OL* is the overall landings and *LA* is landings anchovy.
P_{oi} takes the value 2.5 for the Spanish seines, 0.98-0.61 for French purse-seines during half year 1 and 2 respectively and, finally 2-2.18 for French trawlers during half years 1 and 2 (see Table 2.3.2.1).

2.3.1. Economic indicators

d.1) Gross revenue (GR)

The fleet gross revenue (GR_{it}) (8) is the sum of the anchovy revenues and other fisheries gross revenues:

$$GR_{it} = GR_{ait1} + GR_{ait2} + GR_{oit1} + GR_{oit2} \quad (8)$$

where $GR_{aits} = p_{ait}.Y_{aits}$ and $GR_{oiti} = p_{oi}.Y_{oits}$

d.2) Net revenue (NR)

The net revenue related to anchovy (NR_{ait}) and other species (NR_{oit}) is defined as:

$$NR_{ait} = (1 - \text{Landing fee}_{it}) \times GR_{ait} \quad (9a)$$

$$NR_{oit} = (1 - \text{Landing fee}_{it}) \times GR_{oit} \quad (9b)$$

where the landing fee is a percentage of the gross revenue (*GR*) imputed to anchovy an other species.

d.3) Revenue to be shared: vessels share and crew share

The revenue to be shared (RTBS) is defined as the difference between the net revenue and the so-called "shared cost" (SC)[3]:

$$RTBS_{ait} = NR_{ait} - SC_{ait} \quad (10a)$$

$$RTBS_{oit} = NR_{oit} - SC_{oit} \quad (10b)$$

The shared cost (SC_{it}) for the French and Spanish fleets[4] are respectively:

$$SC_{ait} = (\text{Fuelc}_i + \text{Baitc}_i + \text{Icec}_i + \text{Foodc}_i) \times E_{ait} \times NB_{ai} \text{ for Spanish seines}$$

$$SC_{ait} = (\text{Baitc}_i + \text{Icec}_i + \text{Foodc}_i + SS_i) \times E_{oit} \times NB_{ai} \text{ for French seines and trawlers}$$

The vessels (VS) and crews share (CS) for the given fleet follows respectively:

$$VS_{ait} = \varphi_i.RTBS_{ait} \quad (11a)$$

$$VS_{oit} = \varphi_i.RTBS_{oit} \quad (11b)$$

$$CS_{ait} = (1 - \varphi_i).RTBS_{ait} \quad (12a)$$

$$CS_{oit} = (1 - \varphi_i).RTBS_{oit} \ (\varphi_i \le 1) \quad (12b)$$

d.4) Cash flow

[3] The operating cost data for the Basque purse seines have been derived from an homogeneous vessel type performance operating in the anchovy fishery during the years 2000-04 and are in constant prices (€2007).

Based on the previous equations the fleet cash flow is then:

$FCF_{it} = VS_{ait} + VS_{oit} - (FC_i - SSV_i).NB_{ai}$ for the French fleets (13a)

$FCF_{it} = VS_{ait} + VS_{oit} - FC_i.NB_{ai} - (\text{Fuelc}_i \times NB_{ai})$ for the Spanish fleet (13b)

where FC[5] stands for the fixed costs.

Due to the relative importance of the fuel cost in the total fishing cost and the evolution on fuel prices since the last years, it has been assumed that $Fuelc_i. \sim N(mean_{Fuelc_i}, \theta_{Fuelc_i})$. Moreover, the uncertainty has also extended to fix costs, that is $FC_i. \sim N(mean_{FC_i}, \theta_{FC_i})$.

e) Social indicator

A comparison is made between the average wage derived from the fishing activity and the "normal" average wage ($Wage_{normal}$) of any other economic sector. For doing so we define FTE_i as the full time equivalent of the average vessel for each fleet. Where $FTE = 1$ corresponds to a full-time fisherman, therefore a fleet i that has on average x number of crew working full-time will have $FTE_i = x$.

$$Social\ indicator\ (Fr)_i = \frac{\left(\frac{CS_{ait} + CS_{oit} - SSC_{it}}{FTE_i}\right)}{Wage_{normal}(Fr)} \quad (14a)$$

$$Social\ indicator\ (Sp) = \frac{\left(\frac{CS_{at} + CS_{ot}}{FTE}\right)}{Wage_{normal}(Sp)} \quad (14b)$$

Where values above 1 imply that average wage for these fleets are higher than the one obtained in an alternative economic sector, and the other way around for cases lower than 1.

2.3.2. Model parameters

A list of the economic model estimable parameters is shown in Table 2.3.2.1.

Table 2.3.2.1. Economic model: parameter estimates.

NAME	Comments	SPS	FPS	FPT
r	Discount rate	0,05	0,05	0,05
$\overline{E}$	Maximum time per year	1	1	1
POR_MS_1	Percentage of the anchovy quota by fleet	1	0,058113357	0,941886643
Fuel Cost	Fuel Expenditure in a by year and vessel	82000	22539,43073	98478,29681
Bait Cost	Bait Expenditure in a by year and vessel	0	0	0

[4] For the Spanish fleet a simplification of the shared system has been considered given that the shared costs systems differs between regions.

[5] Social security cost paid by the vessel owner

Ice Cost	Ice Expenditure in a by year and vessel	0	0	0
Food Cost	Food Expenditure in a by year and vessel	0	0	0
Gear Cost	Gear Expenditure in a by year and vessel	6046	0	0
SS Cost	SS Expenditure in a by year and vessel	35867	0	0
OtherVARCost	Other Expenditure in a by year and vessel	20689	9431,266669	11194,12629
LandingCost	% of Income	0,025	0,061548167	0,051355711
Fixed Costs	Fixed Costs	56753	73101,28468	121511,7238
q_{a1}	Catchability first half of the year anchovy	0,0024505	0,0008672	0,0026516
α_{a1}	Elasticity of Number of vessels Sem1	1	1	1
β_{a1}	Elasticity of SSB Sem1	1	1	1
γ_{a1}	Elasticity of Time to anchovy Sem1	1	1	1
q_{a2}	Catchability second half of the year anchovy	0,0038713	0,005077	0,008321
α_{a2}	Elasticity of Number of vessels Sem2	1	1	1
β_{a2}	Elasticity of SSB Sem2	1	1	1
γ_{a2}	Elasticity of Time to anchovy Sem2	1	1	1
NB_1	Number of vessels sem 1	200	31	71
NB_2	Number of vessels sem 2	200	31	71
k_o	Catchability other species	253,11	NA	NA
α_0	Elasticity Number of vessels others	1	1	1
γ_0	Elasticity of Time to others	1	1	1
P_0	Price of other species	2,35	NA	NA
FTE	Average Full time employmet	13	5,886027507	5,554762189
W	Alternative wage	19802	20600	20600
$\overline{E}_1$	Maximum Time Half of the year 1 (months)	0,5	0,5	0,5
Vessel Share	% of RTBS	0,5	0,499550603	0,518781068
% Q by fleet	Percentage of the MS Quota by fleet	1	0,101527086	0,898472914
SSV	SS Paid by the vessel in Ä by year and vessel	0	22310,42551	21054,79593
SSC	SS Paid by the vessel in Ä by year and vessel	0	19982,47262	18857,86011
k_{01}	Catchability “other species” 1st sem	NA	281,745	271,221
k_{02}	Catchability “other specie” 2nd sem	NA	704,406	293,877
P_{01}	Price of “other species” 1st sem	NA	0,98	2
P_{02}	Price of “other species” 2nd sem	NA	0,61	2,18

2.4. Management approaches evaluated

The STECF 2nd meeting on Anchovy management considered the implications for the stock and the fishery of two basic harvest control rules. The rules were tested for four types of constraints and for two basic allocation schemes as described in section 2.2.1.5 and in the Report from the 1st STECF meeting (STECF/SGBRE 0801).

2.4.1. Harvest Control Rules

Two basic strategies were evaluated with respect to what proportion of the available stock could be harvested:

- **Rule A**. constant proportion above an escapement

$$TAC_y = \begin{cases} 0 & \text{if } \hat{SSB}_{y\text{-}1} \le B_{\lim} \\ \gamma(\hat{SSB}_{y-1} - B_{\lim}) & \text{if } \hat{SSB}_{y\text{-}1} > B_{\lim} \end{cases}$$

- **Rule B**. constant proportion

$$TAC_y = \begin{cases} 0 & \text{if } \hat{SSB}_{y\text{-}1} \le B_{lim} \\ \gamma \dfrac{(\hat{SSB}_{y-1} - B_{lim})}{(B_{pa} - B_{lim})} \hat{SSB}_{y-1} & \text{if } B_{lim} < \hat{SSB}_{y\text{-}1} < B_{pa} \\ \gamma \hat{SSB}_{y-1} & \text{if } \hat{SSB}_{y\text{-}1} \ge B_{pa} \end{cases}$$

In both cases $\hat{SSB}_{y-1}$ is the biomass estimated from the spring surveys and γ is a constant parameter to be set. And TAC is applied from subsequent July to June next year. The biological reference points B_{lim} and B_{pa} correspond to 21,000 and 33,000 tones respectively.

The performance of each rule was tested for γ values between 0 and 1 by steps of 0.1.

Rule C

In addition, the following HCR was tested:

$$TAC_y = \begin{cases} 0 & \text{if } \hat{SSB}_{y\text{-}1} \le 26500 \\ 0.766(\hat{SSB}_{y-1} - 26500) & \text{if } \hat{SSB}_{y\text{-}1} > 26500 \end{cases}$$

This rule was selected by fishermen in the SWW RAC that met in March 2008. This was seen at the time, as a compromise between short term risk and their harvest interests. This rule can be considered a special case of rule A where the threshold is 26,500 tonnes and the parameter γ = 0.766. Given the Sector interest in this rule it will be evaluated separately.

2.4.1.1. Constraints

For each of the strategies outlined above, the effect of two additional measures was evaluated. On the one hand, the HCRs with and without a ceiling equal to 33,000 tonnes (the historically fixed level of TAC set to this fishery)

$$TAC_y = \min\{TAC_y, 33000\}.$$

On the other hand the HCRs with and without a minimum TAC corresponding to the smallest catch that allows the fishery to remain economically viable (at 7,000 tonnes, as pointed out by the SWW RAC and confirmed in the economic analysis of this report).

$$TAC_y = \begin{cases} 0 & \text{if } TAC_y < 7000 \\ TAC_y & \text{if } TAC_y \ge 7000 \end{cases}.$$

2.4.2. Summary Statistics

A number of statistics were used to evaluate the performance of the HCR relative to management objectives such as conservation and maximizing yields. The summary statistics presented in this Report are the following:

a) Median SSB (SSB_{med}). Median Spawning Stock Biomass across years and iterations.

b) End SSB ($SSB_{End/last}$). Median of the SSB in the last year of the projection period across iterations.

c) Risk SSB< Blim. Probability of the SSB falling below B_{lim} in any year of the projection period

$$Risk_{SSB<B\lim} = \frac{\sum_{iter,y} I\left[SSB_{iter,y} < B_{\lim}\right]}{N_{iter}\ N_y}$$

d) Risk of SSB<Blim once. Probability of the SSB falling below B_{lim} at least once in the projection period

$$Risk_{SSB<B\lim once} = \frac{\sum_{iter} I\left[\left(\sum_{y} I\left[SSB_{iter,y} < B_{\lim}\right]\right) \geq 1\right]}{N_{iter}}$$

e) Probability of the fishery being closed (i.e. TAC=0) in any year of the projection period

$$p(closure) = \frac{\sum_{iter,y} I\left[TAC_{iter,y} = 0\right]}{N_{iter}\ N_y}$$

f) Probability of the fishery being closed at least once in the projection period

$$p(closure_{once}) = \frac{\sum_{iter} I\left[\left(\sum_{y} I\left[TAC_{iter,y} = 0\right]\right) \geq 1\right]}{N_{iter}}$$

g) Average catch (in tonnes) across years and iterations

$$\overline{C} = \frac{\sum_{iter,y} C_{iter,y}}{N_{iter}\ N_y}$$

h) Average standard deviation of the catch

$$\frac{\sum_{iter} sd_y(C_{iter,y})}{N_{iter}} = \frac{\sum_{iter} \sqrt{\frac{\sum_{y}\left(C_{iter,y} - \overline{C}_{iter}\right)^2}{N_y - 1}}}{N_{iter}}$$

i) Inter-annual catch variation (*ICV*)

$$ICV = \frac{\sum_{iter,y} \frac{TAC_{iter,y+1} - TAC_{iter,y}}{TAC_{iter,y}}}{N_{iter}\left(N_y - 1\right)}$$

In the above equations $SSB_{iter,y}$, $C_{iter,y}$ and $TAC_{iter,y}$ denote respectively the Spawning Stock Biomass, the catch and the TAC in year *y* and iteration *iter*, whereas N_y and N_{iter} are the number of years in the projection period and the number of iterations in the simulation. $I(\cdot)$ is an indicator function that takes the value 1 if the condition within the brackets is fulfilled and 0 otherwise.

2.4.3. Fleet regulation

Given the large variability both in distribution and abundance exhibited by the anchovy the Commission anchovy Non-paper states the following:

To adequately manage this fishery, it is necessary to establish a plan to ensure that the annual effort deployed to the fishery corresponds to the catch possibilities available. Since it would not be possible to establish a fixed effort level per year (due to the fluctuations referred to above) it will be necessary for the MS involved to prepare, in the context of this management plan, an annual effort management plan.
The elements of effort management may have two components:

- *A component of annual adjustment of effort, to reflect the fluctuating nature of the annual biomass available to fish. Given that this fishery is largely conducted by vessels that have other fishing opportunities throughout the year, this may be based on redeployment plans.*

- *A component of capacity adjustment. In the long term scenarios analysed above, average catch availabilities are projected. Over and beyond adaptations to the annual fluctuations, it would also be necessary to evaluate if the current fleets are adequate to catch the average levels of anchovy that would result from the long term plan. To the point that the fleets involved may or may not have alternative species to catch, the Member States involved should reflect how to address the problem of adjusting the effort every year, in a context where the European Fisheries Fund does not allow for unlimited use of public funds for temporary lay-ups. The need for voluntary scrapping should be a function of the possibilities for the concerned fleets to re-deploy to other fisheries when the catch limits for anchovy are low.*

The STECF anchovy group in its 2nd meeting considered the possibility of evaluating the economic impact of regulating fleet size. A scenario of fleet reduction was considered but was not developed because of time constrains.

2.4.4. Considerations regarding closed area measures

The Commission NON-PAPER when considering Long term management for anchovy in Bay of Biscay refers to technical measures and states the following:

Furthermore, time- area closures should also be considered and put into place as part of the plan. An area to protect juveniles, allowing a larger part of the newly recruited to spawn should reinforce the current system. Key nursery areas as the one proposed by ICES in 1999 around the Gironde estuary should be considered whenever the spring assessment reveals a critical level of biomass (say B below B_{pa}). The possibility to establish areas to protect adults during spawning should also be examined. Side effects of this measure and boundaries should be monitored and evaluated by STECF.

An integration of a Random Utility Model fit in ISIS-Fish is under development to evaluate the effect of TACs, Marine Protected Areas and effort regulations on the pelagic fishery, Vermard *et al.* (ICES 2008). ISIS-Fish is a spatially and seasonally explicit simulation tool especially designed to explore

management measures impact on mixed fisheries including fishermen reactions to management. ISIS-Fish had already been used to simulate the pelagic fishery in the Bay of Biscay (Lehuta et al., in prep). The model described the dynamic of the anchovy (*Engraulis encrasicolus)* population and its exploitation but effort allocation was fixed (corresponding to the average historical pattern). To fill this gap, a fleet dynamic model simulating metiers choice using Random Utility Modelling (RUM) was developed including trip components (a lagged value of the main species caught, lagged percentage of effort spent in the different metiers, inertia to change from one metier to another) (Vermard *et al.* 2008). This model is expected to account for the fleet re-distribution both spatially or in the case the effort is re-allocated to other fishes when the closure is imposed. In the case of a spatial re-distribution it is assumed that the fleet continues to target anchovy. The model was parameterised on the basis of survey data of fish distribution and on distribution of the French fleet.

3. Results and Discussion

3.1. Biological Model

3.1.1. Biomass Based Model

Results corresponding to the management strategy evaluation using the biomass based model are presented for the two strategies investigated (Rules A and B) in Figures and Tables 3.1.1.1 and 2 respectively and with further detail in Tables of Appendix II.

For Rule A. Harvesting with a constant proportion above an escapement SSB level:

Table 3.1.1.1: Summary results of the performance of Harvest Control Rule A: Harvesting with a constant proportion above an escapement SSB level. Complete results can be seen in Tables of Appendix I.

HCR	Allocat % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim} once)	P(closure)	P(closure once)	Average catch	Average sd catch
Rule A	cte	ricker	0.1	no	no	81911	0.009	0.055	0.021	0.157	6762	5081
Rule A	cte	ricker	0.2	no	no	70772	0.017	0.115	0.029	0.205	12049	9929
Rule A	cte	ricker	0.3	no	no	61088	0.029	0.186	0.047	0.303	16057	14640
Rule A	cte	ricker	0.4	no	no	55529	0.052	0.293	0.066	0.402	18998	18075
Rule A	cte	ricker	0.5	no	no	48509	0.082	0.446	0.102	0.552	22230	22847
Rule A	cte	ricker	0.6	no	no	44332	0.137	0.631	0.146	0.698	23193	25740
Rule A	cte	ricker	0.7	no	no	39955	0.174	0.722	0.179	0.765	24845	28996
Rule A	cte	ricker	0.8	no	no	35967	0.236	0.819	0.230	0.854	24265	30160
Rule A	cte	ricker	0.9	no	no	32033	0.293	0.890	0.278	0.913	24592	31107
Rule A	cte	ricker	1	no	no	28303	0.331	0.932	0.315	0.935	24854	32952
Rule A	cte	ricker	0.1	33000	no	80266	0.010	0.068	0.023	0.173	6416	4745
Rule A	cte	ricker	0.2	33000	no	70658	0.013	0.090	0.029	0.216	11313	7935
Rule A	cte	ricker	0.3	33000	no	64181	0.026	0.178	0.042	0.293	14294	9617
Rule A	cte	ricker	0.4	33000	no	60222	0.043	0.252	0.060	0.371	16241	10563
Rule A	cte	ricker	0.5	33000	no	56348	0.058	0.337	0.073	0.432	17684	11032
Rule A	cte	ricker	0.6	33000	no	53779	0.075	0.422	0.087	0.500	18747	11532
Rule A	cte	ricker	0.7	33000	no	49222	0.093	0.475	0.104	0.552	19106	11625
Rule A	cte	ricker	0.8	33000	no	47626	0.113	0.546	0.122	0.627	19675	11829
Rule A	cte	ricker	0.9	33000	no	47818	0.132	0.580	0.138	0.640	20242	11945
Rule A	cte	ricker	1	33000	no	45672	0.141	0.614	0.146	0.657	20896	11865
Rule A	cte	ricker	0.1	no	7000	84366	0.008	0.057	0.635	0.999	4622	6339
Rule A	cte	ricker	0.2	no	7000	73316	0.007	0.055	0.377	0.961	10960	11224
Rule A	cte	ricker	0.3	no	7000	63224	0.021	0.134	0.302	0.942	15537	15585
Rule A	cte	ricker	0.4	no	7000	56574	0.040	0.246	0.289	0.922	18850	19285
Rule A	cte	ricker	0.5	no	7000	48899	0.075	0.406	0.292	0.928	21733	23680
Rule A	cte	ricker	0.6	no	7000	43466	0.131	0.603	0.323	0.942	22743	26451
Rule A	cte	ricker	0.7	no	7000	38374	0.172	0.710	0.346	0.967	23819	28816
Rule A	cte	ricker	0.8	no	7000	37158	0.224	0.819	0.368	0.980	24249	30606
Rule A	cte	ricker	0.9	no	7000	31354	0.274	0.862	0.391	0.980	24954	32187
Rule A	cte	ricker	1	no	7000	27677	0.337	0.925	0.435	0.987	24701	34065
Rule A	cte	ricker	0.1	33000	7000	80138	0.007	0.052	0.627	1.000	4599	6052
Rule A	cte	ricker	0.2	33000	7000	72941	0.010	0.070	0.372	0.967	10347	9331
Rule A	cte	ricker	0.3	33000	7000	65856	0.019	0.123	0.296	0.926	13480	10729
Rule A	cte	ricker	0.4	33000	7000	61434	0.032	0.211	0.262	0.893	15718	11462
Rule A	cte	ricker	0.5	33000	7000	56776	0.049	0.295	0.247	0.880	17250	11822
Rule A	cte	ricker	0.6	33000	7000	56767	0.066	0.378	0.242	0.877	18333	12051
Rule A	cte	ricker	0.7	33000	7000	53738	0.083	0.454	0.246	0.881	18907	12414
Rule A	cte	ricker	0.8	33000	7000	48437	0.107	0.535	0.241	0.879	19591	12487
Rule A	cte	ricker	0.9	33000	7000	47285	0.119	0.553	0.242	0.848	20040	12351
Rule A	cte	ricker	1	33000	7000	47769	0.143	0.618	0.242	0.857	20437	12481

The higher the harvest rate (γ) the higher the catches and the biological risks. In addition, the catches are subjected to larger variability. The four cases of different TAC constrains behave quite similarly in terms of risks and average catches up to $\gamma = 0.3$. Above that, those which have a maximum TAC of 33,000 t result in smaller catches (but less variable) and smaller risks than the others at similar harvest rates. Setting a minimum TAC (of 7000 t) increases the chances of closing the fishery, but do not affect the rest of performance indicators.

If no upper TAC ceiling is imposed risks of the stock falling B_{lim} between 5 - 10% correspond to γ = 0.4 - 0.5 (with average catches between 19,000 and 22,000 t). While similar risks correspond to γ between 0.5 and 0.7 (with average catches lower than 19,200 t) when an upper TAC ceiling = 33,000 tonnes is imposed.

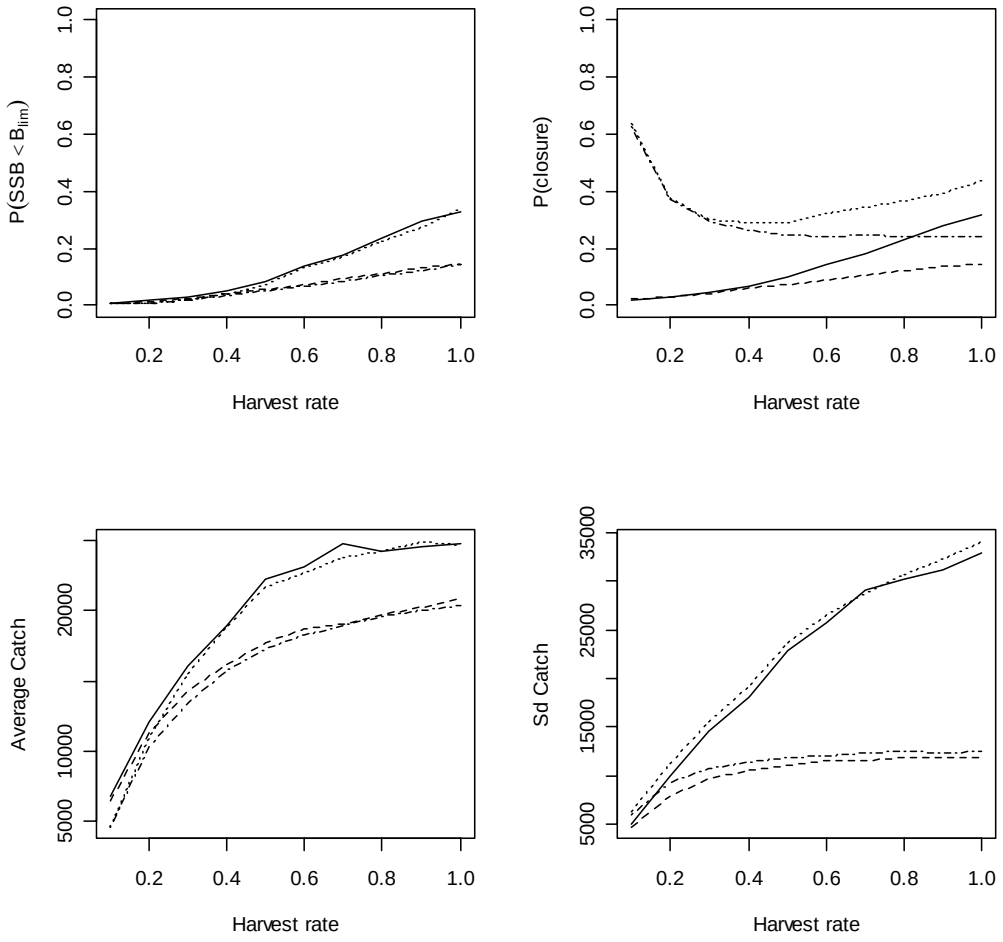


Figure 3.1.1.1: Performance statistics (probability of SSB falling below B_{lim}, probability of closing the fishery, the average catch and average SD in catch)depending on the harvest rate for Rule A (harvesting with a constant proportion above an escapement SSB level) in the biomass model (using BBM) with the Ricker SR model.. Solid, dashed, dotted and dot-dashed lines represent the case without any restriction on the TAC, with a maximum TAC restriction of 33,000 t, with a minimum viable TAC of 7,000 t and with a maximum TAC restriction of 33,000 t and a minimum viable TAC of 7,000 t respectively.

For Rule B. Harvesting a constant proportion of the SSB

Table 3.1.1.2: Summary results of the performance of Harvest Control Rule B. Harvesting a constant proportion of the SSB. Complete results can be seen in Tables of Appendix I.

HCR	Allocat % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	P(closure)	P(closure once)	Average catch	Average sd catch
Rule B	cte	ricker	0.1	no	no	74742	0.017	0.109	0.033	0.217	8145	5132
Rule B	cte	ricker	0.2	no	no	66586	0.033	0.188	0.047	0.297	14791	10115
Rule B	cte	ricker	0.3	no	no	52052	0.068	0.373	0.081	0.461	19423	14776
Rule B	cte	ricker	0.4	no	no	46756	0.124	0.586	0.134	0.666	22681	19557
Rule B	cte	ricker	0.5	no	no	36970	0.206	0.774	0.205	0.820	24106	22717
Rule B	cte	ricker	0.6	no	no	32361	0.263	0.854	0.255	0.880	25718	26215
Rule B	cte	ricker	0.7	no	no	26132	0.353	0.952	0.331	0.948	25600	28724
Rule B	cte	ricker	0.8	no	no	22891	0.438	0.977	0.403	0.986	25024	31364
Rule B	cte	ricker	0.9	no	no	20482	0.493	0.991	0.451	0.993	24775	32497
Rule B	cte	ricker	1	no	no	16997	0.544	0.996	0.497	0.997	23850	33112
Rule B	cte	ricker	0.1	33000	no	79634	0.013	0.090	0.026	0.192	8339	5047
Rule B	cte	ricker	0.2	33000	no	64231	0.033	0.191	0.048	0.300	13961	7995
Rule B	cte	ricker	0.3	33000	no	56043	0.063	0.360	0.078	0.462	17218	9503
Rule B	cte	ricker	0.4	33000	no	49525	0.107	0.516	0.117	0.584	19164	10574
Rule B	cte	ricker	0.5	33000	no	47530	0.145	0.607	0.156	0.677	20384	11309
Rule B	cte	ricker	0.6	33000	no	43325	0.172	0.668	0.172	0.709	21423	11745
Rule B	cte	ricker	0.7	33000	no	40997	0.204	0.738	0.194	0.748	21629	12220
Rule B	cte	ricker	0.8	33000	no	37040	0.236	0.769	0.228	0.797	21352	12665
Rule B	cte	ricker	0.9	33000	no	39843	0.242	0.776	0.234	0.807	21582	12792
Rule B	cte	ricker	1	33000	no	36248	0.268	0.800	0.252	0.822	21345	12973
Rule B	cte	ricker	0.1	no	7000	79209	0.008	0.054	0.479	0.994	6551	6911
Rule B	cte	ricker	0.2	no	7000	66498	0.023	0.156	0.188	0.779	14219	10553
Rule B	cte	ricker	0.3	no	7000	54622	0.061	0.343	0.196	0.790	19204	15429
Rule B	cte	ricker	0.4	no	7000	45459	0.108	0.531	0.227	0.854	22947	19962
Rule B	cte	ricker	0.5	no	7000	37439	0.202	0.761	0.300	0.940	24029	23085
Rule B	cte	ricker	0.6	no	7000	32910	0.276	0.891	0.350	0.961	25283	26622
Rule B	cte	ricker	0.7	no	7000	27644	0.356	0.946	0.411	0.984	25790	29732
Rule B	cte	ricker	0.8	no	7000	24286	0.420	0.973	0.466	0.995	24771	31354
Rule B	cte	ricker	0.9	no	7000	19245	0.493	0.989	0.512	0.998	24628	32537
Rule B	cte	ricker	1	no	7000	20094	0.533	0.990	0.546	0.998	24151	33630
Rule B	cte	ricker	0.1	33000	7000	83760	0.007	0.048	0.479	0.992	6480	6681
Rule B	cte	ricker	0.2	33000	7000	68240	0.022	0.145	0.187	0.782	13524	8626
Rule B	cte	ricker	0.3	33000	7000	57626	0.060	0.334	0.182	0.750	17268	10121
Rule B	cte	ricker	0.4	33000	7000	52933	0.093	0.488	0.211	0.825	19191	11224
Rule B	cte	ricker	0.5	33000	7000	44863	0.138	0.624	0.241	0.857	19877	11661
Rule B	cte	ricker	0.6	33000	7000	40147	0.181	0.690	0.264	0.857	20596	12284
Rule B	cte	ricker	0.7	33000	7000	41276	0.203	0.743	0.274	0.881	21069	12799
Rule B	cte	ricker	0.8	33000	7000	38213	0.244	0.792	0.297	0.877	20935	12923
Rule B	cte	ricker	0.9	33000	7000	34291	0.244	0.775	0.286	0.872	21515	12908
Rule B	cte	ricker	1	33000	7000	35121	0.267	0.803	0.306	0.887	21164	13291

The results are quite similar to the former case in general terms: The higher the harvest rate (γ) the higher the catches and the risks, in addition the catches are subjected to larger variability. The four cases of different TAC constrains behave quite similarly in terms of risks and average catches up to $\gamma = 0.3$, but above that, those which have a maximum TAC of 33,000 t result in lower catch and risk than the others. Setting a minimum TAC (of 7000 t) increases the chances of closing the fishery, but do not affect the rest of performance indicators.

In the cases without TAC constrain, risks between 5 - 10% for the stock of falling below B_{lim} correspond to $\gamma = 0.3$, with average catch around 19,500 t. For rules with upper TAC constrain = 33,000 t and similar associated risk the catch is around 17,200 t.

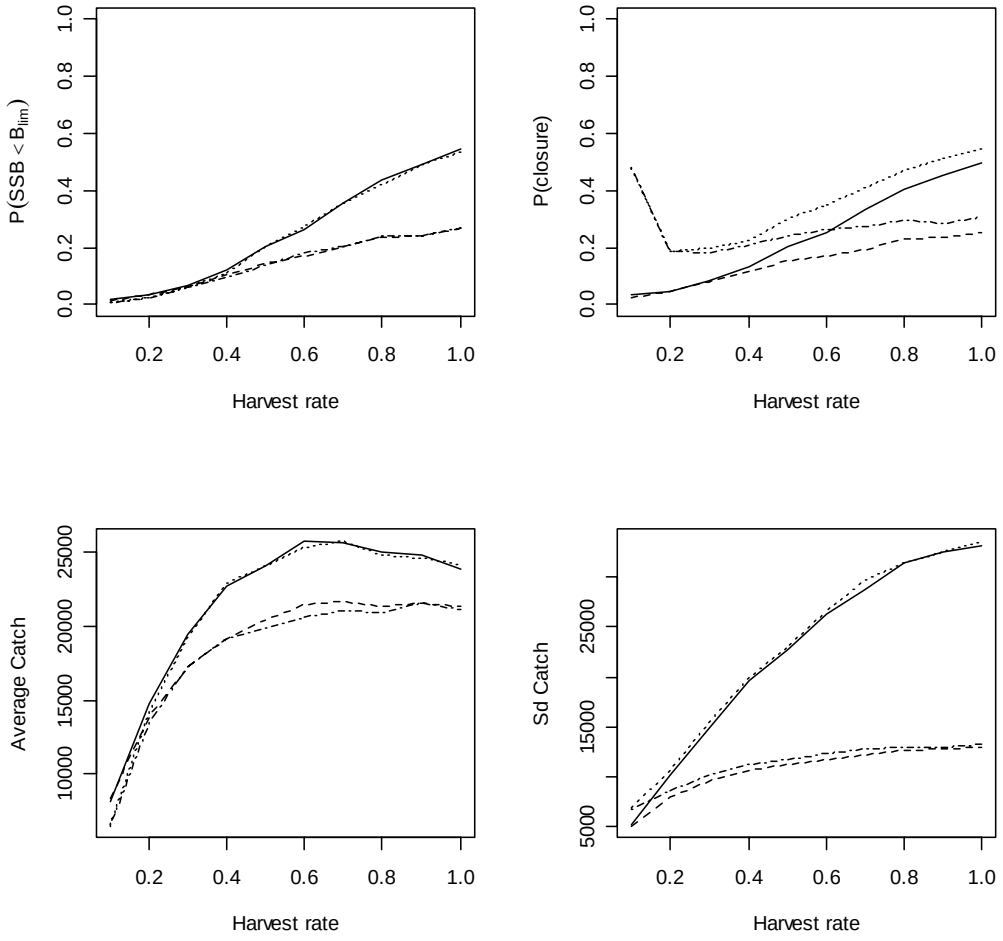


Figure 3.1.1.2: Performance statistics (probability of SSB falling below B_{lim}, probability of closing the fishery, the average catch and average sd in catch) depending on the harvest rate γ for Rule B (harvesting a constant proportion of the SSB) in the biomass model (using BBM) with the Ricker SR model.. Solid, dashed, dotted and dot-dashed lines represent the case without any restriction on the TAC, with a maximum TAC restriction of 33,000 t, with a minimum viable TAC of 7000 t and with a maximum TAC restriction of 33,000 t and a minimum viable TAC of 7000 t respectively.

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For both HCRs (A and B) imposing an upper limit of 33,000 tonnes to the TAC results in lower catch and lower associated variability and probability of SSB being below B_{lim} than the case where no ceiling was imposed. Setting a minimum TAC of 7,000 tonnes, to have a viable fishery, do not change the performance of the rules except for increasing the probabilities of closures, i.e. similar catches are obtained for the same harvest rates at similar risks (see Fig. 3.1.1.3).

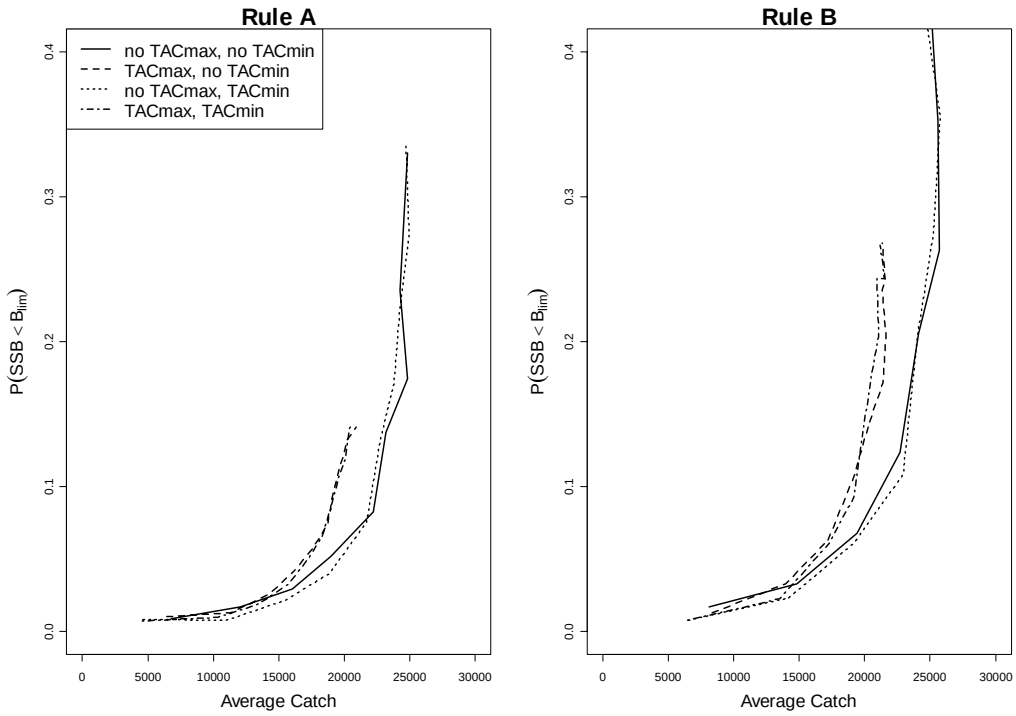


Figure 3.1.1.3: Catches versus Risks for both HCR A and B according to the different TAC constraints

Setting a minimum TAC level of 7,000 tonnes, to have a viable fishery, does not change the performance of the rules except for increasing the probabilities of closures, i.e. similar catches are obtained for the same harvest rates at similar risks.

Comparison of the performance of Rules A and B:

For the same harvest rate (γ) and TAC constraints, Rule A - Harvesting with a constant proportion above an escapement SSB level - seems to be more precautionary in terms of implying less risks for the stock of falling below B_{lim}, due to yielding lower average catches and allowing higher population levels than Rule B - Harvesting a constant proportion of the SSB-.

Both Rules behave very similarly for a similar average expected catch, although risk appears to increase slightly faster in the case of rule B. (Figure 3.1.1.3). However, variability in catch reflected by the Standard deviation of the catch may be higher for Rule A.

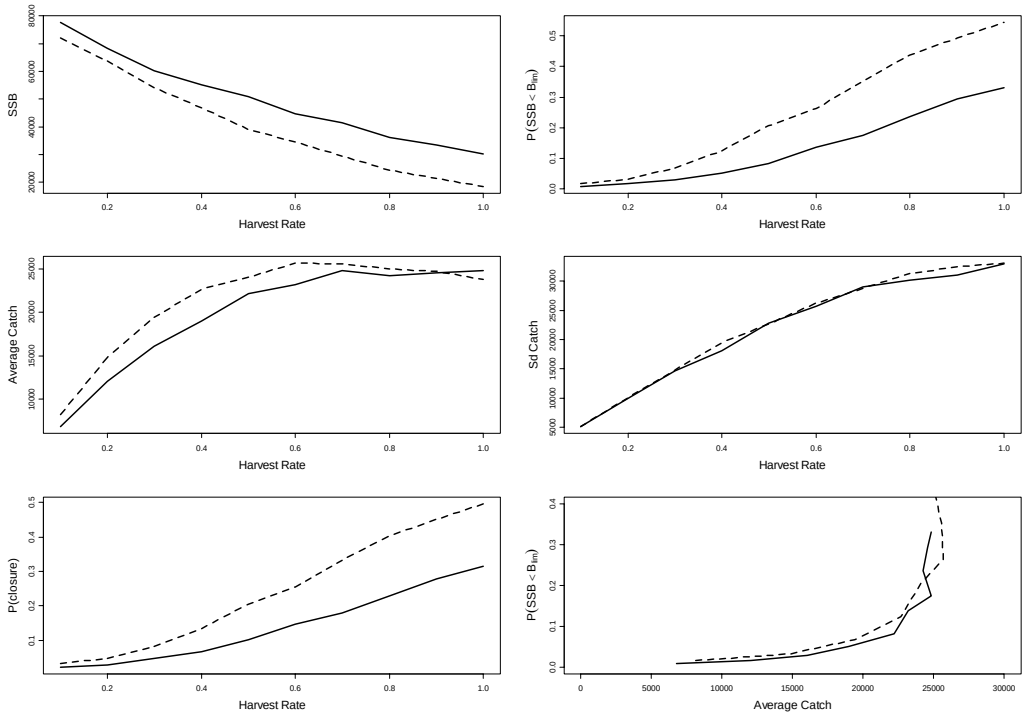


Figure 3.1.1.4: Comparison of the Performance of the two basic harvest rules: Rule A. Harvesting a constant proportion above an escapement SSB level (solid line) and Rule B: harvesting a constant proportion of the SSB (dashed line), for the biomass model (using BBM) with the Ricker SR model and no minimum or maximum TAC constraint (SSB is the median SSB at the end of the period).

Sensitivity to the Stock Recruitment Model

The complete performance statistics for both base Rules A and B for the biomass model according to the different Stock Recruitment models selected in this study can be examined in Appendix II. An example of the sensitivity of Harvest Control Rule A (harvesting a constant proportion above an escapement level) to the selected Stock Recruitment Relationship is presented in Figure 3.1.1.5 for illustration.

The HCRs explored are not sensitive to the use of either the Ricker or the Quadratic Hockey Stick SR models, (just negligible increases on final SSB estimates and catches, at similar biological risk levels), since both fitted models are very similar (section 2.3.1.1). However, the influence of persistent low recruitment is major. This would lead to lower biomass and higher probabilities of SSB of falling below B_{lim} and of the fishery being closed though with far lower catches than for the normal SRRs. In the low recruitment model catches would always be on average below 9,000t with associated risk > 10% of falling below B_{lim} in any year of the simulations, regardless the selected harvest rate.

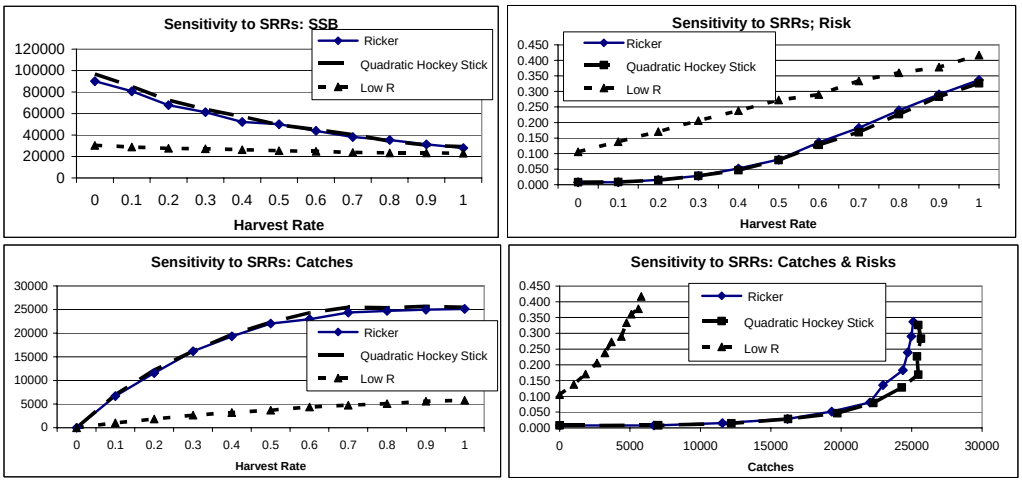


Figure 3.1.1.5: Comparison of the Performance of the basic harvest Rule A. Harvesting a constant proportion above an escapement SSB level for the different Stock Recruitment Models selected for the analysis: Ricker and Quadratic Hockey Stick SR models and continuous Low Recruitment Levels. Risk is measured as the Probability of falling below B_{lim} in any year of the 10 years of projection.

3.1.2. Age structured Model

Sensitivity to the Population and Fishery Model.

In this section the age structure model is reviewed and its table are updated for a longer number of iterations than the ones achieved for the first meeting's report, including small corrections in the inputs. Hence, these are the tables of reference for the age structured model.
The robustness of the results to the underlying population model was studied in detail by comparing the performance statistics resulting from the biomass model with the age-structured model (Ricker SR model). Tables 3.1.1.21 and 2 show the performance statistics for the age-structured model for Rules A and B. Complete results can be found in Tables of Appendices II and III. Note that in most cases, results are based on 500 simulations (see tables 3.1.1.2.1 and 2), although only 100 simulations were performed at the extremes of the γ range explored because of time constrains.

Figures 3.1.1.2.1 and 2 compare the probability of the population of being at biological risk, the probability of having the fishery closed, the average catch and the variation in the catch depending on the harvest rate (γ parameter) for Rule A and B. The results in terms of the influence of the harvest rate are similar to the ones from the biomass model: the higher γ the higher the catch and the associated risk. In addition the role of the different TAC constrains is also similar: Above γ = 0.4 the rules start to diverge, those that have a maximum TAC of 33,000 t result in lower catch and risk than the others. Setting a minimum TAC (of 7000 t) increases the chances of closing the fishery, but on average do not affect the rest of performance indicators.

In the age-structured model as for the Biomass based model the Harvest control Rule A results in lower biological risk than rule B for a given γ. This is because for the same γ, the catch resulting from the rule A is lower and the resulting biomass is higher than for rule B.

Comparing the results from the biomass model and the age-structured (see two examples in Figure 3.1.1.2.3), the major difference is that the probability of SSB being below B_{lim} is higher for the biomass model for a given harvest rate. In addition, although to a lesser extend, for the same average catch the associated risk is higher for the biomass model. This is because for harvest rates (γ) above 0.5 the age-structured model results in higher biomass levels and generally, across γ, in lower catch. Certainly, the average catch and the standard deviation of the catch are slightly higher in the Biomass model.

The reasons for the difference in performance between models were investigated and the conclusions are the following:

- Small differences in the parameterization of the Stock and Recruitment relationship and their uncertainty around the curve. As shown in section 2.1.1.3 of the first STECF report, Maximum Recruitment is higher (by about 10%) for the biomass model than for the Age structured model. Consequently, the age structured model at zero or low harvest rates results in smaller spawning biomass than the biomass model. In addition Figure 6.3.1.3 of that section shows that the shape of the SRRs for the Age structured model is slightly more productive at lower SSB so that it generates higher recruitments than with the Biomass model of SRRs at low biomass levels. This implies a higher resilience to exploitation of the population for the age structured model than for the biomass model, leading to higher biomasses at higher harvest rates in this model.
- Differences in the Growth and Natural Mortality balance between the two models: particularly the age structured model assumes different mean weight at age in the stock and in the catch.
    - Mean weight at age in the stock: As actual growth in the stock of ages 2+ is smaller than the one modelled by the biomass model, for the same mortality pattern surviving biomasses are smaller for the age structured model than for the biomass model. This

makes that the age structured model at null or low harvest rates results in smaller spawning biomass than the biomass model. At higher harvest rates the differences diminish because the relative contribution of biomass at old ages diminishes as well. And the other factors mentioned here above and below make the SSB of the age structured model to overtake the biomass model at higher harvest rates reducing risks.

  - Mean weight in the catch: they are higher than in the stock, therefore, a lower fishing mortality is required in the age-structured model than in the biomass model to take a given TAC. This is because the biomass model assumes implicitly that the mean weight at age in the catch is the same as in the stock. As a result, the age-structured model reaches equilibrium at higher SSBs. This is particularly noticeable when exploitation rate is high.

- Fishing mortality in the age-structured model is continuous while in the biomass model catch is taken as a pulse three times a year. These results in lower mortality and higher survivorship for a given catch in the age-structured model compared to the biomass model.
- The age-structured model uses the selectivity fishing pattern applied on a half-year basis while the selectivity in the biomass model is flat.

The age-structured model has correct growth and selectivity inputs as measured from surveys and from past assessments. Although more heavily parameterised than the biomass model the model is defensible and provides an alternative to test sensitivity of the results to model structure.

Table 3.1.1.2.1: Summary results of the performance of Harvest Control Rule A. Harvesting with a constant proportion above an escapement SSB level for the population model (age structured model) . Complete results can be seen in Tables of Appendix III. Given time limitations results are based on 100 or 500 simulations (ITERS).

HCR	Allocat	SR	HR	ITERS	TAC_{max}	TAC_{min}	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	P(closure)	P(closure once)	Average catch	Average sd catch
Rule A	cte	ricker	0	100	no	no	80.251	0.01	0.05	1.00	1.00	0.000	0.00
Rule A	cte	ricker	0.1	100	no	no	73.417	0.00	0.03	0.02	0.20	4.967	3.55
Rule A	cte	ricker	0.2	500	no	no	64.844	0.01	0.04	0.03	0.26	9.187	7.05
Rule A	cte	ricker	0.3	500	no	no	62.557	0.01	0.05	0.03	0.24	12.734	10.08
Rule A	cte	ricker	0.4	500	no	no	56.406	0.01	0.09	0.04	0.30	15.898	13.41
Rule A	cte	ricker	0.5	500	no	no	51.568	0.03	0.18	0.06	0.40	18.809	16.61
Rule A	cte	ricker	0.6	500	no	no	49.099	0.04	0.29	0.07	0.50	21.038	19.02
Rule A	cte	ricker	0.7	500	no	no	42.716	0.07	0.45	0.10	0.62	22.971	21.99
Rule A	cte	ricker	0.8	500	no	no	42.635	0.10	0.60	0.12	0.70	24.322	24.12
Rule A	cte	ricker	0.9	100	no	no	36.227	0.13	0.69	0.17	0.81	24.078	24.85
Rule A	cte	ricker	1	100	no	no	39.717	0.13	0.72	0.15	0.78	27.527	27.30
Rule A	cte	ricker	0	100	33.000	no	78.033	0.01	0.03	1.00	1.00	0.000	0.00
Rule A	cte	ricker	0.1	100	33.000	no	70.613	0.01	0.05	0.02	0.15	4.744	3.51
Rule A	cte	ricker	0.2	500	33.000	no	65.423	0.01	0.04	0.02	0.19	9.328	6.97
Rule A	cte	ricker	0.3	500	33.000	no	58.751	0.01	0.06	0.03	0.24	12.911	9.21
Rule A	cte	ricker	0.4	500	33.000	no	56.802	0.01	0.08	0.04	0.31	15.097	10.64
Rule A	cte	ricker	0.5	500	33.000	no	58.877	0.02	0.15	0.05	0.36	16.930	11.18
Rule A	cte	ricker	0.6	500	33.000	no	52.483	0.03	0.19	0.06	0.40	18.175	11.66
Rule A	cte	ricker	0.7	500	33.000	no	51.390	0.04	0.29	0.07	0.47	19.041	12.06
Rule A	cte	ricker	0.8	500	33.000	no	48.749	0.06	0.39	0.09	0.57	19.464	12.51
Rule A	cte	ricker	0.9	100	33.000	no	55.733	0.08	0.50	0.10	0.59	20.269	12.51
Rule A	cte	ricker	1	100	33.000	no	44.580	0.07	0.41	0.11	0.67	20.076	12.78
Rule A	cte	ricker	0	100	no	7.000	73.770	0.01	0.05	1.00	1.00	0.000	0.00
Rule A	cte	ricker	0.1	100	no	7.000	70.275	0.01	0.04	0.75	1.00	2.536	4.41
Rule A	cte	ricker	0.2	500	no	7.000	64.465	0.00	0.01	0.45	1.00	7.941	8.38
Rule A	cte	ricker	0.3	500	no	7.000	61.369	0.00	0.03	0.33	0.96	12.389	11.54
Rule A	cte	ricker	0.4	500	no	7.000	55.851	0.01	0.06	0.29	0.96	15.518	14.35
Rule A	cte	ricker	0.5	500	no	7.000	53.444	0.02	0.14	0.27	0.94	18.376	17.05
Rule A	cte	ricker	0.6	500	no	7.000	48.047	0.03	0.25	0.27	0.93	20.212	19.57
Rule A	cte	ricker	0.7	500	no	7.000	46.378	0.07	0.42	0.28	0.94	22.430	22.07
Rule A	cte	ricker	0.8	500	no	7.000	43.606	0.09	0.57	0.29	0.95	24.137	25.00
Rule A	cte	ricker	0.9	100	no	7.000	37.261	0.12	0.68	0.30	0.98	25.433	27.77
Rule A	cte	ricker	1	100	no	7.000	38.359	0.14	0.77	0.30	0.97	26.516	28.07
Rule A	cte	ricker	0	100	33.000	7.000	78.722	0.01	0.05	1.00	1.00	0.000	0.00
Rule A	cte	ricker	0.1	100	33.000	7.000	81.797	0.00	0.02	0.70	1.00	3.216	5.03
Rule A	cte	ricker	0.2	500	33.000	7.000	65.636	0.00	0.03	0.45	0.99	8.019	8.36
Rule A	cte	ricker	0.3	500	33.000	7.000	59.215	0.00	0.04	0.33	0.97	11.914	10.26
Rule A	cte	ricker	0.4	500	33.000	7.000	59.775	0.01	0.05	0.28	0.92	14.478	11.46
Rule A	cte	ricker	0.5	500	33.000	7.000	57.456	0.01	0.11	0.25	0.92	16.232	11.95
Rule A	cte	ricker	0.6	500	33.000	7.000	57.101	0.02	0.18	0.23	0.87	17.887	12.50
Rule A	cte	ricker	0.7	500	33.000	7.000	51.585	0.04	0.27	0.22	0.87	18.762	12.68
Rule A	cte	ricker	0.8	500	33.000	7.000	52.586	0.04	0.30	0.22	0.88	19.627	12.93
Rule A	cte	ricker	0.9	100	33.000	7.000	52.461	0.05	0.33	0.21	0.84	20.449	13.06
Rule A	cte	ricker	1	100	33.000	7.000	50.559	0.05	0.34	0.21	0.84	20.919	12.91

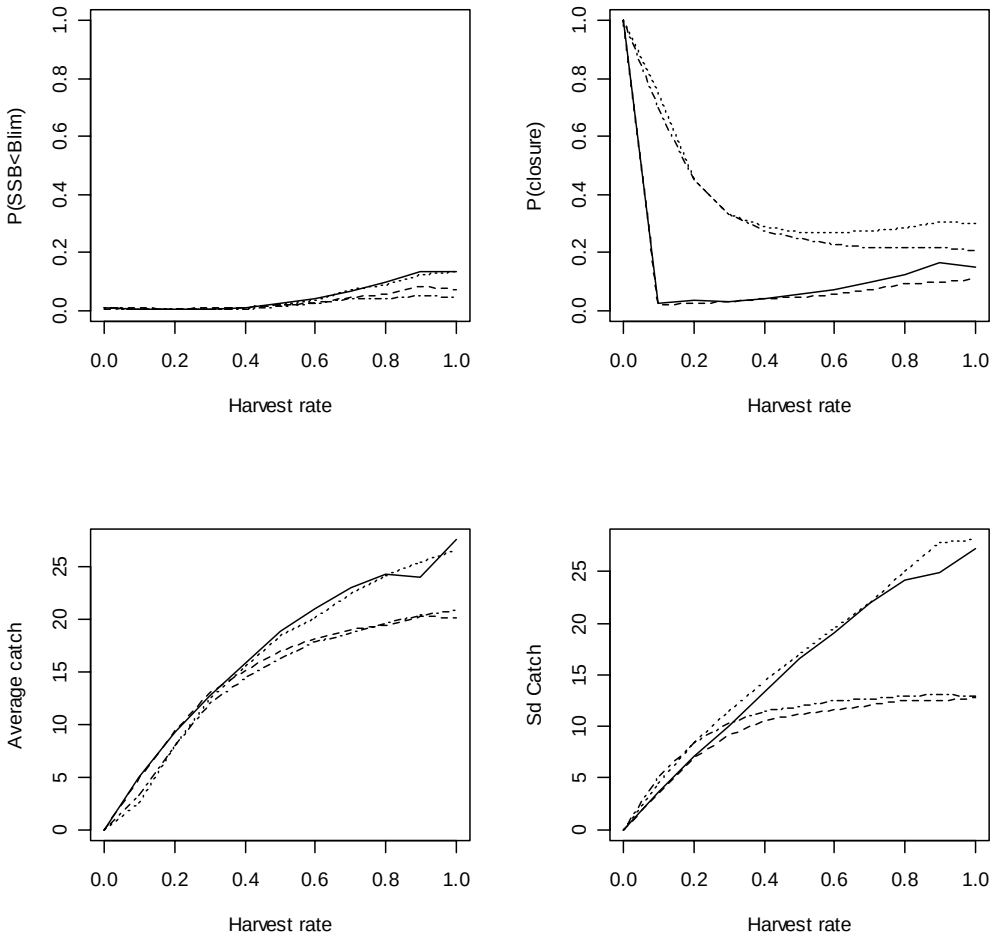


Figure 3.1.1.2.1: Performance statistics depending on the harvest rate for Harvest Rule A. Harvesting with a constant proportion above an escapement SSB level, in the case using age structured population dynamics with the Ricker SR model.

Table 3.1.1.2.2: Summary results of the performance of Harvest Control Rule B. Harvesting a constant proportion of the SSB, for the age-structured population model . Complete results can be seen in Tables of Appendix III. Number of simulations is either 100 or 500 (ITERS).

HCR	Allocat	SR	HR	ITERS	TAC_{max}	TAC_{min}	Median SSB_{last}	$P(SSB<B_{lim})$	$P(SSB<B_{lim}$ once)	P(closure)	P(closure once)	Average catch	Average sd catch
Rule B	cte	ricker	0	100	no	no	79.803	0.00	0.02	1.00	1.00	0.000	0.00
Rule B	cte	ricker	0.1	500	no	no	69.466	0.00	0.03	0.02	0.19	6.971	3.91
Rule B	cte	ricker	0.2	500	no	no	64.117	0.01	0.09	0.03	0.25	12.585	7.66
Rule B	cte	ricker	0.3	500	no	no	52.820	0.02	0.16	0.06	0.38	17.137	11.37
Rule B	cte	ricker	0.4	500	no	no	47.012	0.05	0.34	0.08	0.55	20.452	14.67
Rule B	cte	ricker	0.5	500	no	no	42.085	0.09	0.54	0.12	0.67	23.610	18.40
Rule B	cte	ricker	0.6	500	no	no	38.945	0.14	0.70	0.16	0.78	26.208	21.66
Rule B	cte	ricker	0.7	100	no	no	34.060	0.22	0.87	0.23	0.91	25.910	24.21
Rule B	cte	ricker	0.8	100	no	no	29.397	0.25	0.90	0.27	0.92	26.878	26.02
Rule B	cte	ricker	0.9	100	no	no	33.938	0.26	0.94	0.27	0.98	30.633	30.06
Rule B	cte	ricker	1	100	no	no	28.495	0.31	0.95	0.33	0.98	31.291	32.49
Rule B	cte	ricker	0	100	33.000	no	71.499	0.00	0.04	1.00	1.00	0.000	0.00
Rule B	cte	ricker	0.1	500	33.000	no	65.908	0.00	0.04	0.02	0.21	6.655	3.79
Rule B	cte	ricker	0.2	500	33.000	no	64.476	0.01	0.07	0.03	0.26	12.362	7.28
Rule B	cte	ricker	0.3	500	33.000	no	55.441	0.03	0.18	0.06	0.41	15.899	9.57
Rule B	cte	ricker	0.4	500	33.000	no	53.586	0.04	0.30	0.08	0.49	19.023	11.01
Rule B	cte	ricker	0.5	500	33.000	no	48.554	0.08	0.46	0.11	0.60	20.471	11.85
Rule B	cte	ricker	0.6	500	33.000	no	45.261	0.10	0.54	0.12	0.66	21.846	12.50
Rule B	cte	ricker	0.7	100	33.000	no	45.219	0.13	0.69	0.15	0.77	22.094	13.24
Rule B	cte	ricker	0.8	100	33.000	no	47.484	0.13	0.65	0.14	0.68	23.056	13.18
Rule B	cte	ricker	0.9	100	33.000	no	39.139	0.17	0.71	0.17	0.74	22.940	13.65
Rule B	cte	ricker	1	100	33.000	no	46.344	0.14	0.73	0.17	0.81	23.683	13.71
Rule B	cte	ricker	0	100	no	7.000	74.378	0.01	0.04	1.00	1.00	0.000	0.00
Rule B	cte	ricker	0.1	500	no	7.000	72.528	0.00	0.03	0.58	1.00	4.500	5.41
Rule B	cte	ricker	0.2	500	no	7.000	65.727	0.01	0.05	0.20	0.84	12.181	8.44
Rule B	cte	ricker	0.3	500	no	7.000	58.691	0.02	0.17	0.19	0.85	16.640	12.02
Rule B	cte	ricker	0.4	500	no	7.000	50.263	0.05	0.32	0.20	0.85	20.173	14.85
Rule B	cte	ricker	0.5	500	no	7.000	44.977	0.09	0.55	0.23	0.91	23.710	18.89
Rule B	cte	ricker	0.6	500	no	7.000	39.408	0.14	0.69	0.27	0.94	25.246	21.75
Rule B	cte	ricker	0.7	100	no	7.000	36.567	0.20	0.81	0.33	0.99	25.798	25.19
Rule B	cte	ricker	0.8	100	no	7.000	33.064	0.23	0.91	0.34	0.99	27.547	26.72
Rule B	cte	ricker	0.9	100	no	7.000	27.350	0.25	0.97	0.34	1.00	30.198	29.35
Rule B	cte	ricker	1	100	no	7.000	26.309	0.35	0.98	0.42	1.00	27.849	30.62
Rule B	cte	ricker	0	100	33.000	7.000	79.582	0.00	0.03	1.00	1.00	0.000	0.00
Rule B	cte	ricker	0.1	500	33.000	7.000	70.927	0.00	0.02	0.58	1.00	4.520	5.50
Rule B	cte	ricker	0.2	500	33.000	7.000	59.634	0.01	0.07	0.22	0.86	11.525	8.06
Rule B	cte	ricker	0.3	500	33.000	7.000	58.534	0.02	0.15	0.18	0.79	16.347	10.16
Rule B	cte	ricker	0.4	500	33.000	7.000	52.590	0.05	0.32	0.20	0.83	18.472	11.55
Rule B	cte	ricker	0.5	500	33.000	7.000	50.533	0.07	0.42	0.20	0.85	20.584	12.37
Rule B	cte	ricker	0.6	500	33.000	7.000	45.558	0.10	0.55	0.22	0.89	21.362	13.04
Rule B	cte	ricker	0.7	100	33.000	7.000	48.827	0.11	0.61	0.20	0.80	23.291	13.01
Rule B	cte	ricker	0.8	100	33.000	7.000	49.928	0.12	0.62	0.22	0.88	23.076	13.69
Rule B	cte	ricker	0.9	100	33.000	7.000	43.554	0.15	0.69	0.23	0.85	22.919	14.03
Rule B	cte	ricker	1	100	33.000	7.000	36.434	0.19	0.77	0.25	0.87	22.516	14.18

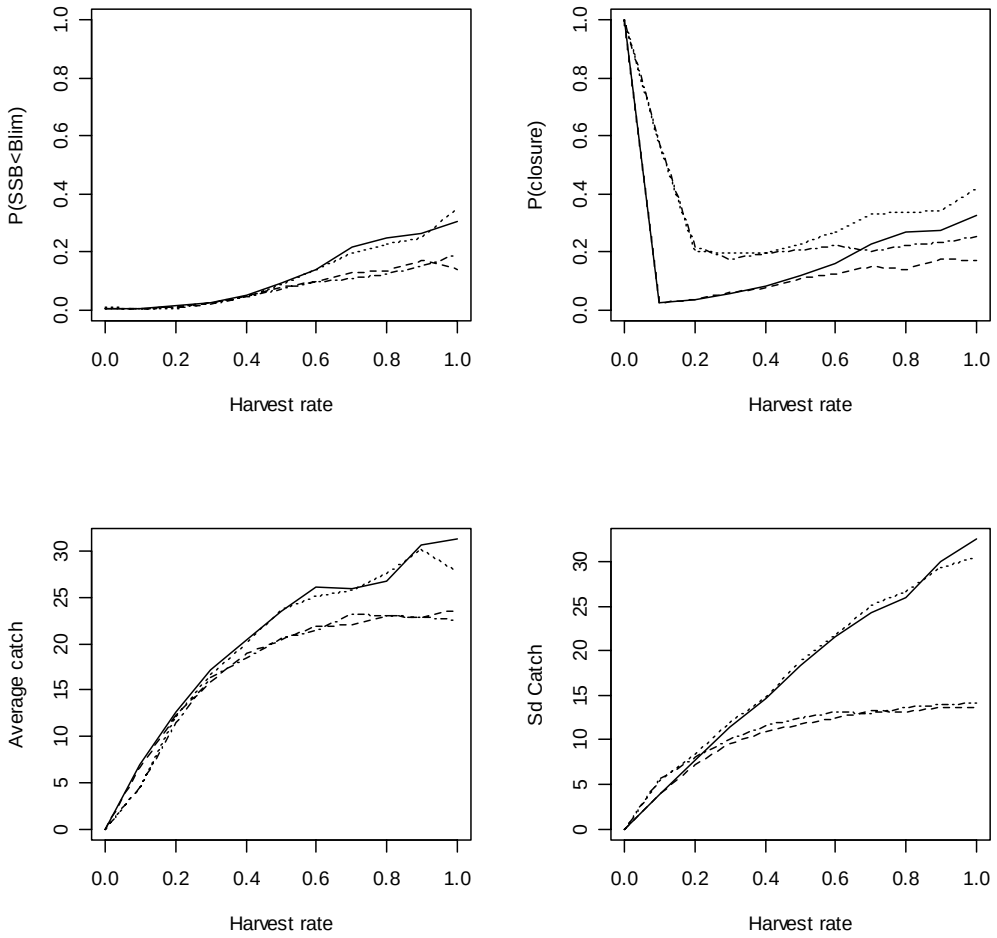
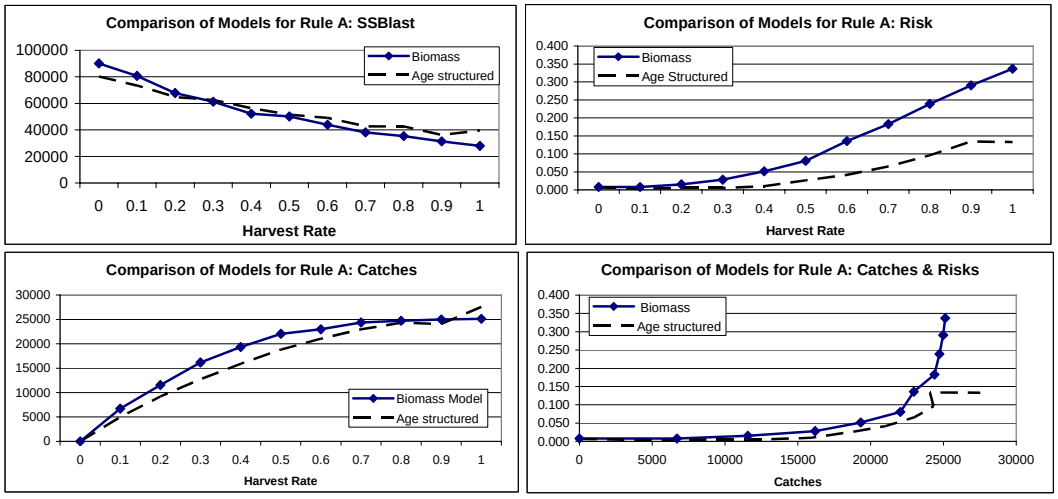


Figure 3.1.1.2.2: Performance statistics depending on the harvest rate for Rule B. Harvesting a constant proportion of the SSB in the age-structured model assuming the Ricker SR model.

1- No TAC max & No TAC min for Rule A



2 TAC max = 33.000 t & TAC min = 7000 t for Rule A

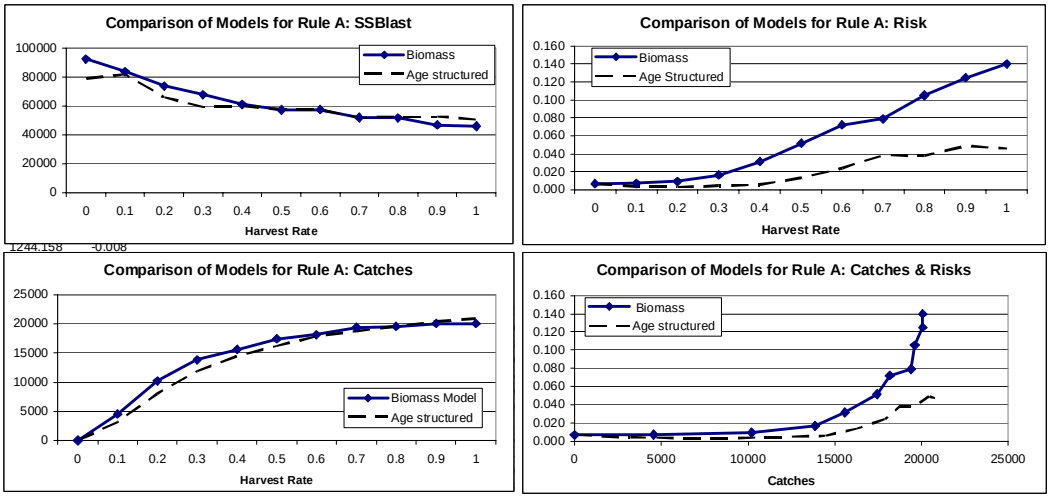


Figure 3.1.1.2.3: Relative Performance of Rule A for the Biomass based and age structure Models depending on the harvest rate with the Ricker SR model for two cases: 1- Upper panels without any TAC constraint and 2- with maximum and minimum TAC levels.

3.1.3. Performance of Rule C

Table 3.1.3.1 summarises the performance statistics for the Harvest Control Rule C in the biomass model, i.e. where the population dynamics is based on the Biomass based Model and the SR model is Ricker, quadratic hockey stick or low. In general, for this Harvest control Rule case C as for former cases A & B, imposing an upper limit of 33,000 tonnes to the TAC gets smaller catches and variability on the catches with lower probabilities of SSB being below B_{lim}. Setting a minimum TAC of 7,000 tonnes in order to have a viable fishery has a similar effect, though to a lesser extend. HCR 1 is more or less equivalent to Harvest Control Rules A and B for γ around 0.6.

As before, there are almost no differences under the Ricker and the quadratic hockey stick SR models, whereas the low recruitment model leads lower biomass levels with subsequent higher probabilities of SSB falling below B_{lim} and of the fishery being closed, and certainly low catches.

Table 3.1.3.1: Performance statistics for Rule C (selected by Fishermen) in the using Biomass Based Mode) with different SR models.

HCR	Allocat	SR	TACmax	TACmin	Median SSBlast	P(SSB<Blim)	P(SSB<Blim once)	P(closure)	P(closure once)	Average catch	Average sd catch
Rule C	cte	ricker	no	no	41354	0.160	0.676	0.257	0.894	24240	31089
Rule C	cte	ricker	33000	no	53456	0.076	0.418	0.164	0.741	18586	12376
Rule C	cte	ricker	no	7000	40920	0.164	0.667	0.398	0.984	24145	31691
Rule C	cte	ricker	33000	7000	52095	0.063	0.363	0.279	0.922	18471	12873
Rule C	cte	qhstk	no	no	39992	0.167	0.672	0.258	0.896	23755	29981
Rule C	cte	qhstk	33000	no	53692	0.071	0.382	0.157	0.714	18708	12355
Rule C	cte	qhstk	no	7000	42098	0.143	0.610	0.379	0.980	25292	32124
Rule C	cte	qhstk	33000	7000	53954	0.065	0.367	0.272	0.892	18858	12626
Rule C	cte	low	no	no	25907	0.255	0.903	0.517	0.999	3533	5429
Rule C	cte	low	33000	no	25778	0.254	0.920	0.517	1.000	3519	5336
Rule C	cte	low	no	7000	26892	0.240	0.873	0.786	1.000	2843	5570
Rule C	cte	low	33000	7000	26369	0.225	0.872	0.776	1.000	2945	5718
Rule C	var	ricker	no	no	38423	0.169	0.702	0.264	0.904	23450	30079
Rule C	var	ricker	33000	no	53563	0.075	0.398	0.159	0.714	18418	12191
Rule C	var	ricker	no	7000	42540	0.157	0.658	0.397	0.989	23684	30418
Rule C	var	ricker	33000	7000	55220	0.070	0.364	0.274	0.917	18629	12950
Rule C	var	qhstk	no	no	41660	0.167	0.671	0.254	0.880	24510	30556
Rule C	var	qhstk	33000	no	53276	0.077	0.408	0.164	0.722	18604	12187
Rule C	var	qhstk	no	7000	42881	0.154	0.627	0.396	0.982	23873	30746
Rule C	var	qhstk	33000	7000	54539	0.067	0.356	0.274	0.898	18761	12749
Rule C	var	low	no	no	25202	0.269	0.922	0.527	1.000	3515	5448
Rule C	var	low	33000	no	26134	0.266	0.905	0.526	1.000	3486	5401
Rule C	var	low	no	7000	26753	0.230	0.867	0.783	1.000	2918	5771
Rule C	var	low	33000	7000	26816	0.233	0.861	0.781	1.000	2912	5699

When comparing the results from the biomass based with the age structured model (Table 3.1.3.2), the probability of SSB being below B_{lim}, the probability of having the fishery closed, the average catch and the standard deviation of the catch are larger for the biomass based. The major underlying differences of both models are the SR model, and therefore the productivity of the stock, and the fishing selectivity pattern.

Table 3.1.3.2: Performance statistics for Rule C using an age-structured model with the Ricker SR model

HCR	Allocat	SR	TAC_{max}	TAC_{min}	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim} once)	P(closure)	P(closure once)	Average catch	Average sd catch
Rule C	cte	ricker	no	no	51.620	0.056	0.360	0.183	0.890	22.354	23.287
Rule C	cte	ricker	33000	no	49.804	0.032	0.220	0.148	0.760	17.044	12.853
Rule C	cte	ricker	no	7000	44.515	0.064	0.440	0.349	0.990	21.093	24.082
Rule C	cte	ricker	33000	7000	48.559	0.033	0.240	0.316	0.980	16.961	13.582

3.2. Economic Analysis

In this section the economic analysis of the different management alternatives have been performed.

The economic model presented in the previous section was run for all the management alternatives and the results were analysed in terms of some indicators. These indicators take into account the following:

- Prices by year
- Discounted gross revenue obtained from anchovy and overall by year.
- Discounted Cash flow by fleet and overall by year.
- Probability of negative cash flow for each fleet by year.
- Comparison between the mean wage by country and the estimated wage by FTE by year.

All these results are available but, given the number of cases tested, their presentation is limited to summary graphs which provide the evolution of selected indicators along the different harvest rates (γ, gamma).

The selected indicators are:

- The overall discounted gross revenue obtained from the anchovy (1000€).
- The overall and by fleet discounted cash flow (1000€).
- The probability of negative cash flow (%).
- The social indicator (relative to 1)

Given that Rules A and B perform similarly it is not necessary to repeat all the analysis for both rules.

The economic model has been coded for this specific economic evaluation. Furthermore, the model was validated by gradually introducing uncertainty.

3.2.1. Model validation

The model has been run in a stochastic way. It is ready for introducing uncertainty in almost all the estimated parameters, but the limited time has only allowed introducing some uncertainty: biological uncertainty and, economic uncertainty. The last one was introduced by adding a random effect to the production function of "other" species rather than anchovy.

Hence the full analysis has been performed using sequentially a deterministic model, including biological uncertainty, and finally adding uncertainty on the production function of other species.

The validation of the model has been done for both rules (A and B) but in this section only results for Rule A will be presented.

3.2.1.1. The deterministic model

The deterministic model has been run using the median of the biomass as well as the median of the TAC for each harvest rate. Following that only one price for each half of the year is calculated using its median value. Also, the production function for anchovy is calculated once for each half of the year and fleet using the median of the biomass distribution.

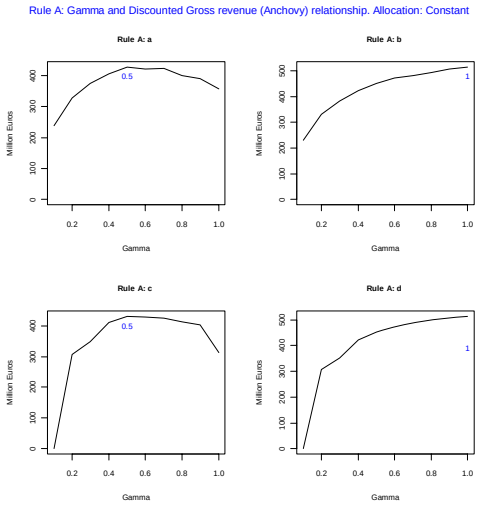


Figure 3.2.1.1.1: Harvest rate and discounted gross revenue obtained from anchovy using constant allocation and a deterministic model.

Results from the biological model show how options with a maximum TAC of 33,000 tonnes (cases b and d) give average maximum catch values of around 2,0000 tonnes while cases a and c (without this maximum) give maximum catch values around 24,000-25,000.

As we have shown in the price function section, income increases with the TAC up to 32,000 tonnes (although this value depends on the allocation that we are assuming) which suggests that the best harvest rate should be the one which allows higher catches (a and c). However, in those cases the discounting is affecting the results.

Options with a maximum TAC of 33000 tonnes (cases b and d) attain their maximum value at harvest rates $\gamma = 1$ while those without this maximum attain their maximum values between 0.5 and 0.8. Given that in all cases the highest catches are attained with the highest harvest rate (or almost), implicitly we are considering that it is not the mean catch attained which counts but also the evolution of the catch in the projections period.

3.2.1.2. Incorporating biological uncertainty

When the biological uncertainty is incorporated prices and catchabilities for the production function of anchovy are calculated 1,000 times (using all the iterations provided in the biomass models). Results shown correspond to median values.

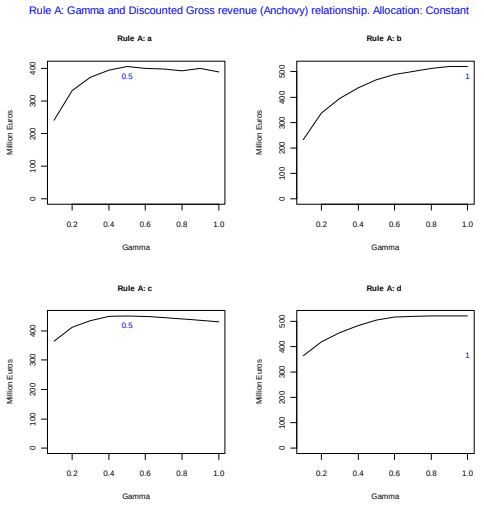


Figure 3.2.1.2.1: Harvest rate and discounted Gross revenue obtained from anchovy using constant allocation and including biological uncertainty.

As it can be seen maximum gross revenue are obtained at the same harvest rates. However, in the case where no maximum TAC is incorporated (cases a and c) there could be some iterations were the TAC was above the observed range of catches used for estimating the price function. Therefore, these findings should be interpreted with caution.

The uncertainty provides the possibility of calculating the number of times that the overall cash flow is negative. That is, the risk of a negative overall cash flow, which is shown in the following graphs.

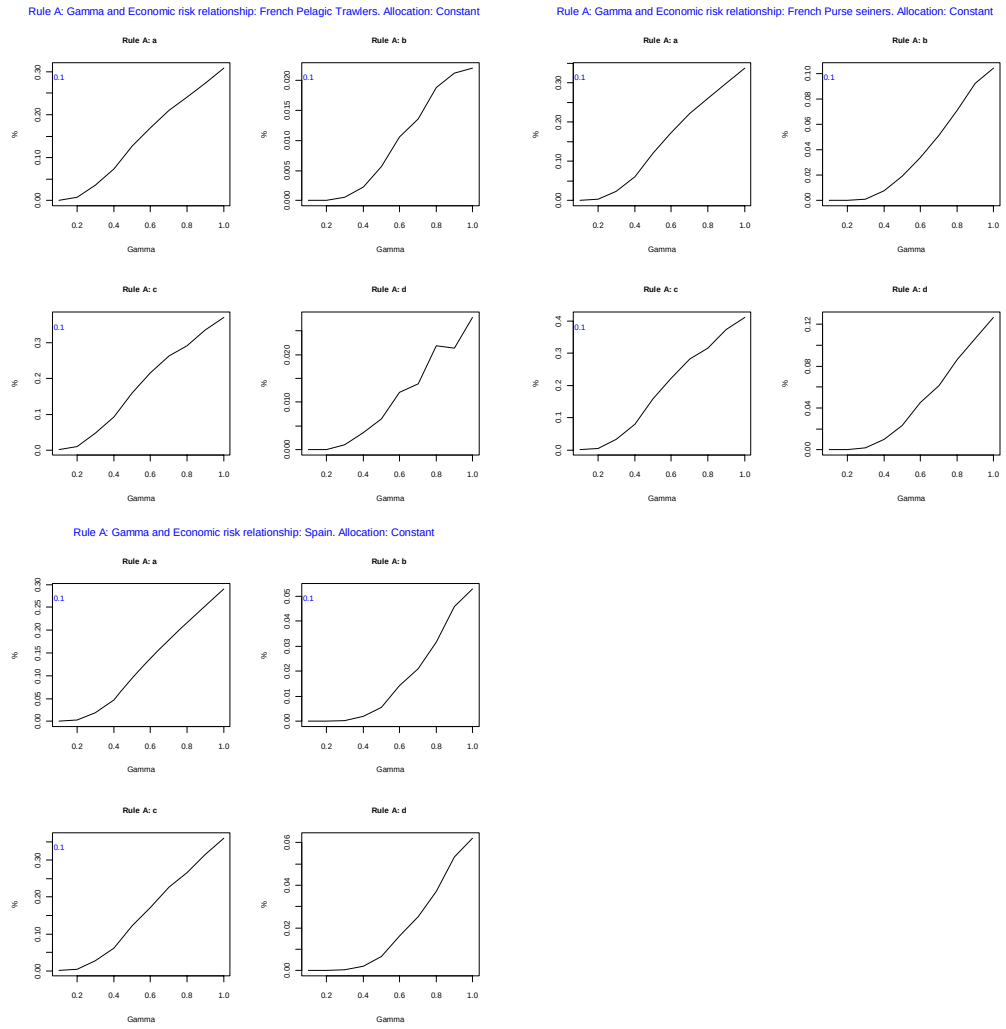


Figure 3.2.1.2.2: Harvest rate and Economic risk obtained using constant allocation for the three fleets.

3.2.1.3. Incorporating uncertainty on the production function of "others"

We have also run the model with a coefficient of variance for the parameter *k* (catchability of "other" species) of 25% for all fleets and half year. The reason for doing so is the importance that the production function of the rest of the species has on the performance of the fleets. In the simulations, we are assuming that the "other" species are always available to the anchovy fleet which may not necessarily be the case.

In terms of the gross revenue obtained from the anchovy there are no significant differences as a result of adding uncertainty in *k*. This is because we are always assuming that the total catch is going to be caught by the fleets. However, in terms of the probability of having a negative cash flow there are some interesting differences. Results are shown below:

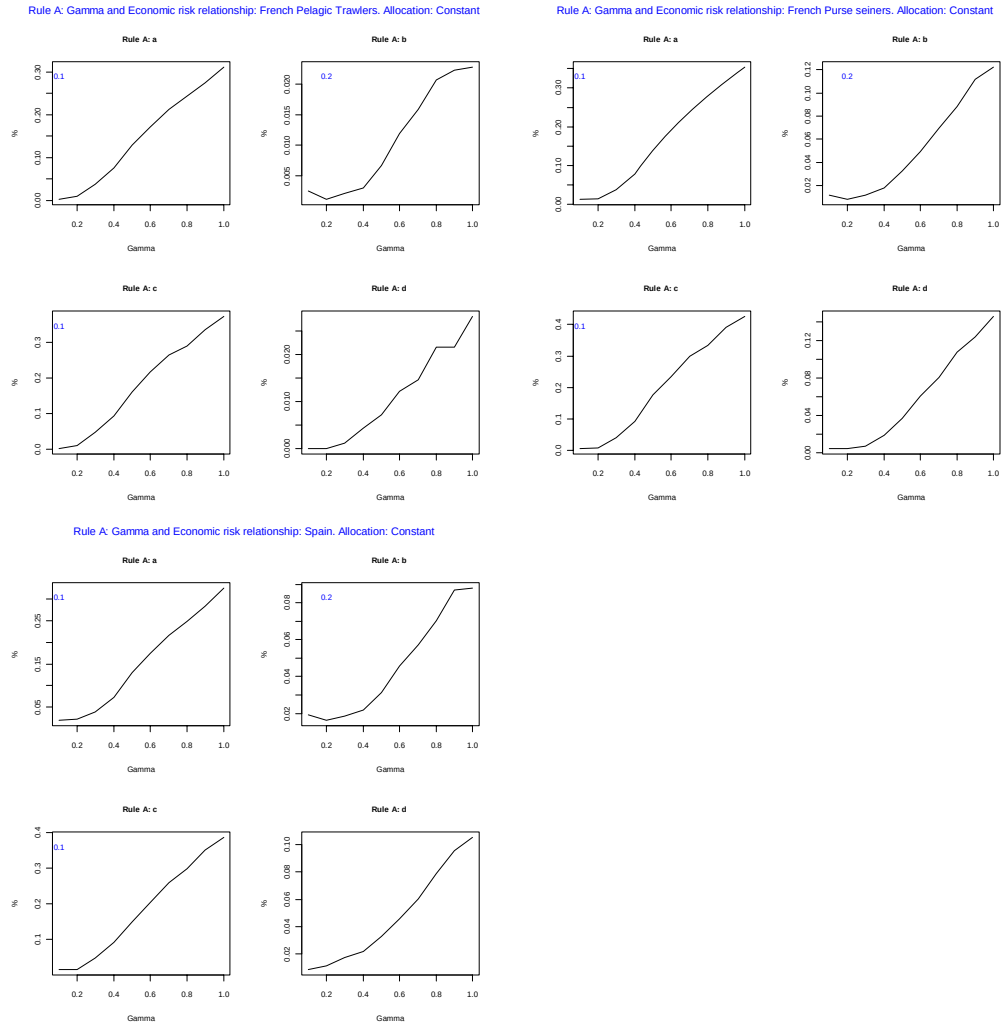


Figure 3.2.1.3.1: Harvest rate and Economic risk obtained using constant allocation for the three fleets and uncertainty on the production function of "other" species

The incorporation of the uncertainty in *k* results in a reduction the probability of negative cash flow. The reason for that is that now the availability (in terms of catchability) of "other" species is variable and not constant.

In all cases above, and for all the fleets, the risks of having a negative cash flow decreases substantially when applying the HCR with an upper TAC of 33,000t

3.2.1.4. Some other considerations to validate the model.

As stated before there are some other uncertainties both in the model and in the parameters used for the simulation that were not taken into account. Prices, and costs parameters as well as the production functions for anchovy are under some degree of uncertainty but the group chose not to incorporate them given the short time to perform the analysis and hence to validate the results.

3.2.2. Economic evaluation of the HCR A

Simulations were run for all the possibilities. Rule A and B, the four TAC constraints (a, b, c and d), all the harvest rates (from 0.1 to 1) and for different allocation possibilities (Constant allocation, variable allocation, 90% (Spain)-10% (France), 80% (Spain)-20% (France) , 70% (Spain)-30% (France) and 60% (Spain)-40% (France).

Given that Rules A and B perform similarly only Rule A is going to be shown, and also only for constant and variable allocation, for the case when biological as well as uncertainty in the production function of other species is taken into account. Results for the two rules and for different allocations are shown on tables in Appendix IV.

3.2.2.1. Constant allocation

Gross revenue for anchovy

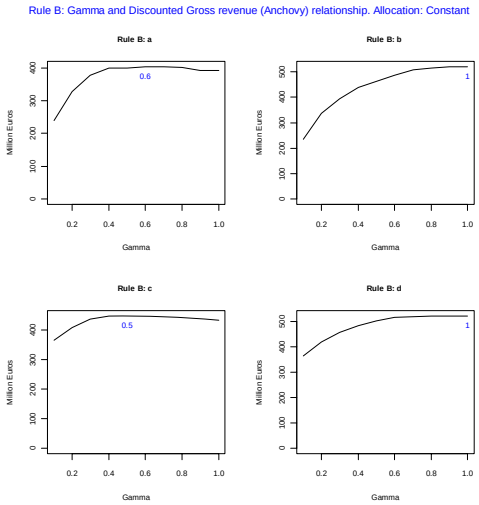


Figure 3.2.2.1.1.: Harvest rate and discounted Gross revenue obtained from anchovy using constant allocation.

For the constant allocation, discounted income increases with the harvest rate except for the cases where a maximum TAC is not considered. In these two last cases there could be some iterations where that TAC is high enough to reduce the price in such a way that there is not worthy in terms of income to increase the harvest rate. This result should be considered carefully given that the price function has been estimated with observed catches below the range of the extreme values of some of the iterations considered[6].

[6] In any case the deterministic runs also have showed this result, (while the median is within the range of estimation of the price function).

For intermediate and high harvest rates it seems that the rules with a maximum TAC of 33,000 t result in higher discounted gross revenues.

Cash flow per fleet

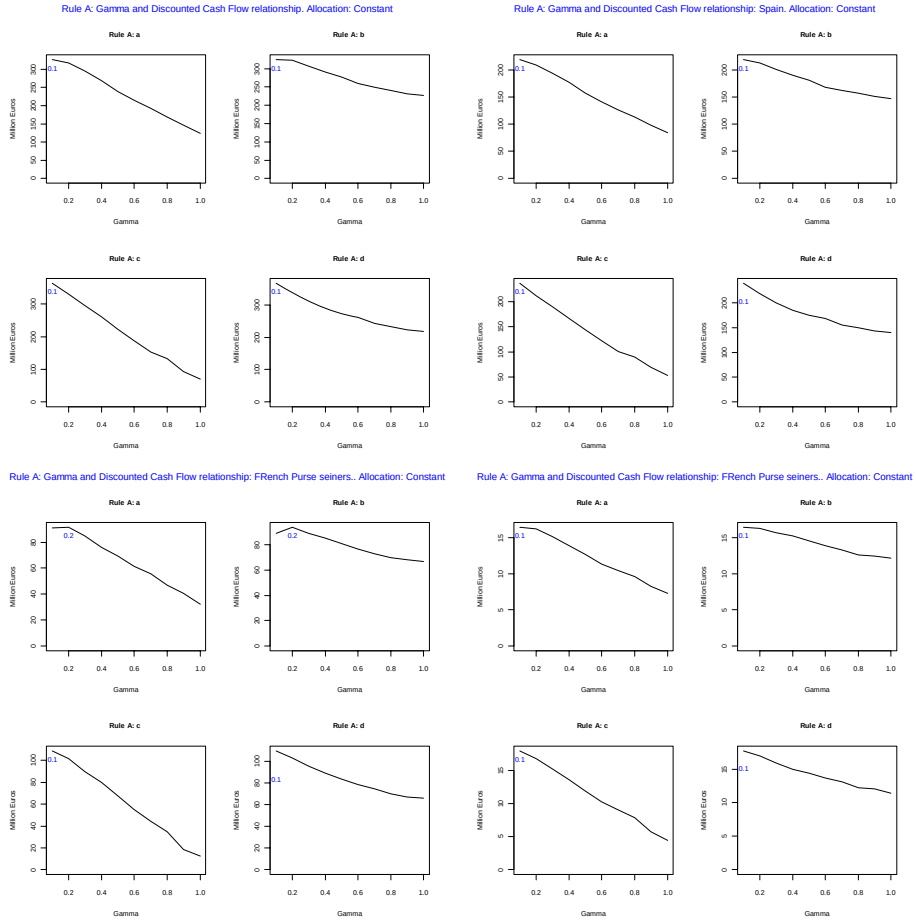


Figure 3.2.2.1.2: Discounted Cash flow (overall and by fleet) and harvest rate relationship using constant allocation.

Cash flow is showing results quite opposite to the gross revenue. The lowest the harvest rate (γ) the higher the cash flow obtained. This result is due to the opportunities that the model is providing for fishing some other species, which makes more profitable to fish small amounts of anchovy since it implies a higher price and then fish the other species whose price was assumed constant. Further developments of the model should try to avoid this effect. A more in depth analysis of the production function would be helpful.

Note that the reduction of cash flow at increasing harvest rate is less steep when a TAC maximum is imposed.

Probability of negative Cash flow per fleet

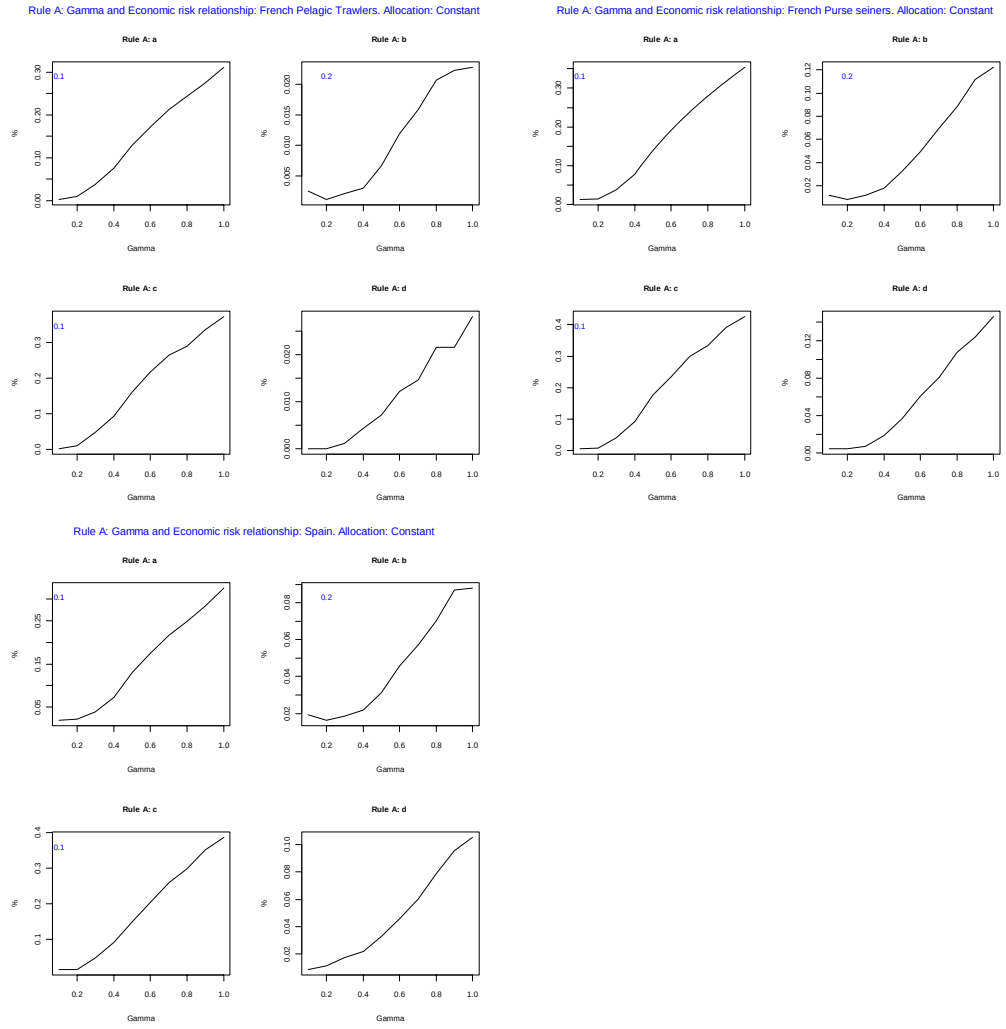


Figure 3.2.2.1.3: Economic risk (overall and by fleet) and harvest rate relationship using constant allocation.

The probability of having a negative cash flow was computed as the number of iterations (in percentage) which results in a negative cash flow. Again, note there are significant differences in associated risk between the cases where a maximum TAC is imposed and where it is not; the risk being lower where there is a maximum.

Social indicators per fleet

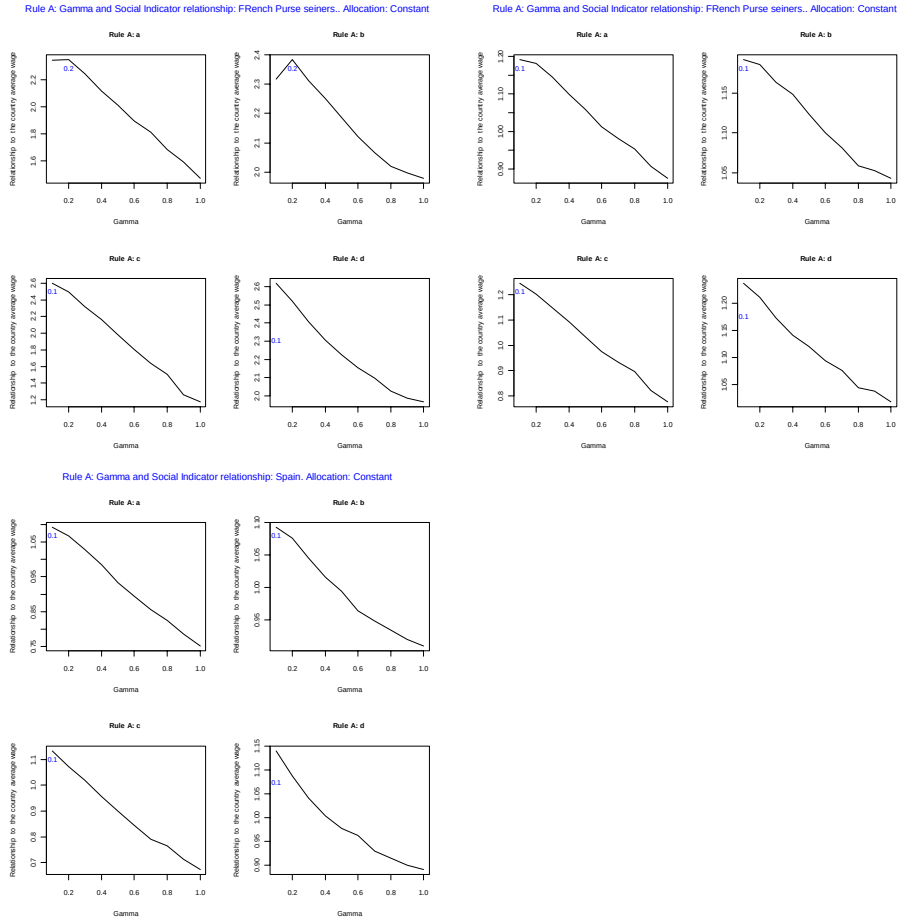


Figure 3.2.2.1.4: Social indicator by fleet and harvest rate relationship using constant allocation.

Purse seiners of both member stated face values around 1 for the whole sequence of harvest rate, which is remarkable given that there are vessels of different size and with different share systems. In any case the assumptions made: constant number of vessels, constant FTE and constant costs are clearly affecting these results.

3.2.2.2. Variable allocation

Gross revenue for anchovy

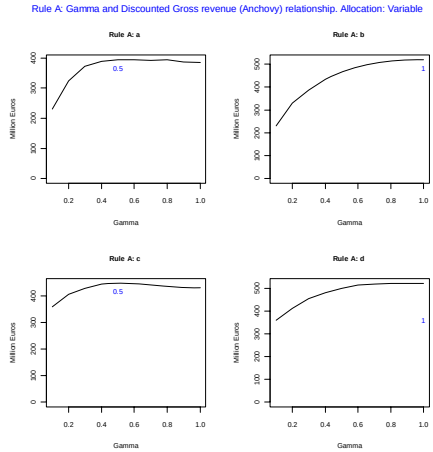


Figure 3.2.2.2.1: Harvest rate and discounted Gross revenue obtained from anchovy using variable allocation.

In the case of variable allocation the results in terms of gross revenue, optimum harvest rates and overall values are similar to the constant allocation. Differences are not significant.

Cash flow per fleet

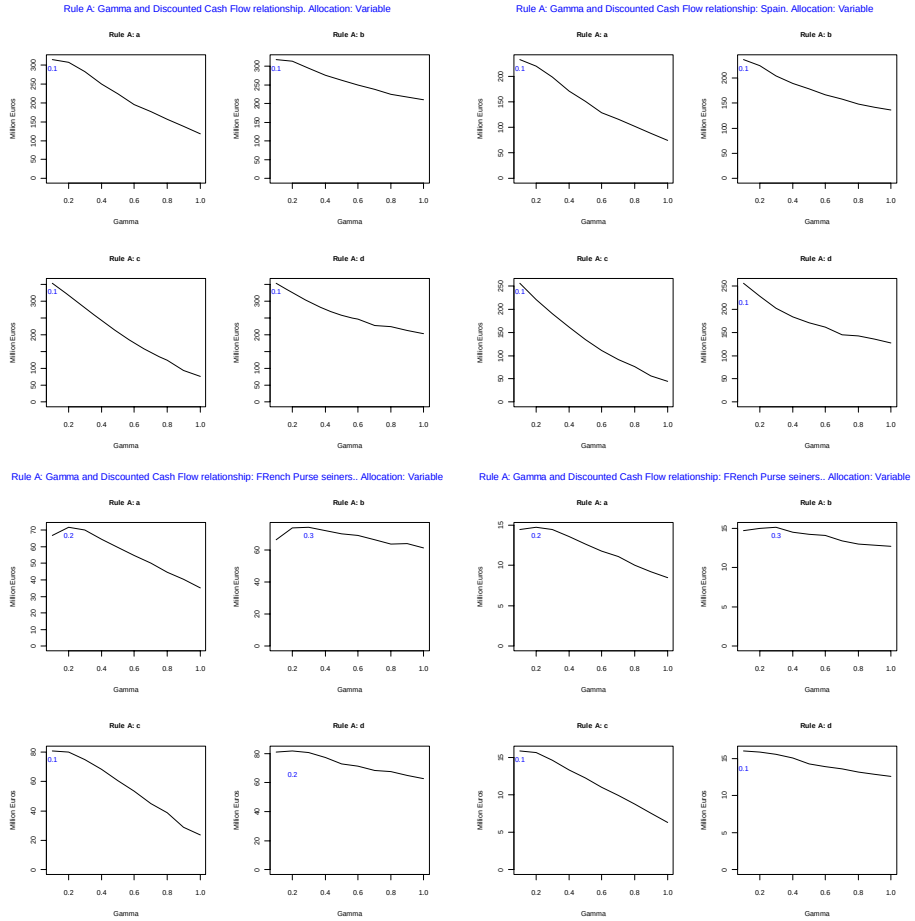


Figure 3.2.2.2.2: Discounted Cash flow (overall and by fleet) and harvest rate relationship using variable allocation.

When the Cash flow is considered, in overall terms the results are the same as when constant allocation is used, but now the French fleets would prefer higher harvest rates to compensate the lower quota that are receiving.

Probability of negative Cash flow per fleet

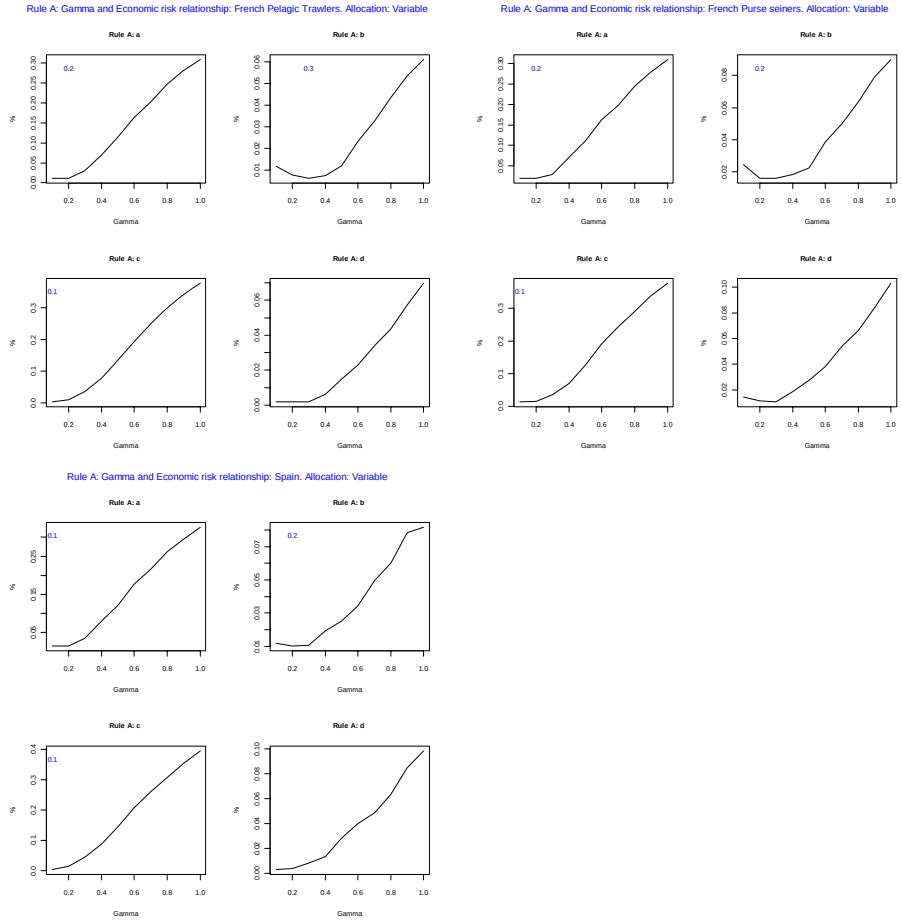


Figure 3.2.2.2.3: Economic risk (overall and by fleet) and harvest rate relationship using variable allocation.

The probability of negative cash flow is just slightly higher but follows the same pattern as the constant allocation.

Social indicator per fleet

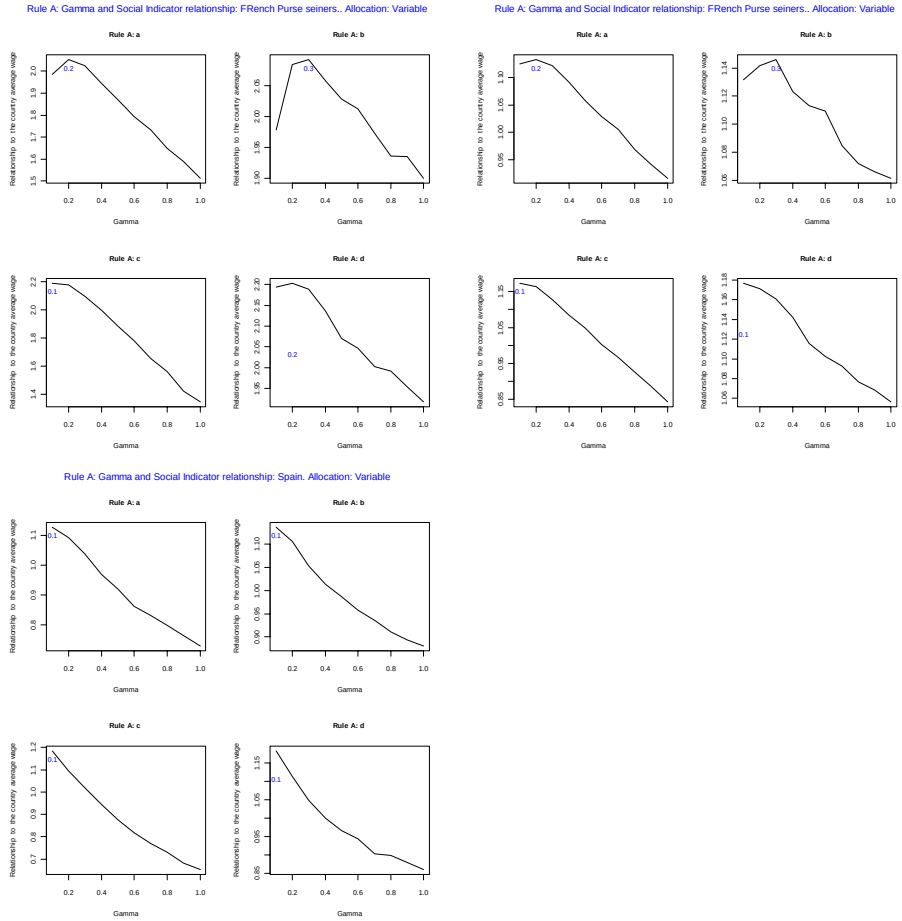


Figure 3.2.2.2.4: Social indicator by fleet and harvest rate relationship using variable allocation.

In overall terms the social indicator is slightly worse for French pelagic trawlers and slightly better for the Spanish purse seiners. The structure is similar to the constant allocation.

3.2.2.3. Other allocation methods

As commented before some other allocation methods were also tested. Specifically, the one based on the relative stability principle (i.e. 90% to Spain and 10% to France), and intermediate options: 80-20, 70-30 and 60-40. Results show how the probability of negative cash flow are overall reduced for Spain and increased for France. But given the effect of other species these changes are not dramatic. Results for these allocations are shown in the tables at the end of this section.

4. Conclusions

4.1. Biological Model

- The higher the exploitation rate the higher the catch, its variability and associated risk.
- Setting a maximum TAC reduces maximum attainable catch and decreases inter-annual variability in TACs (Fig.3.1.1.1 & 2). For a given harvest rate an upper TAC of 33,000 t reduces catches, their variability and the associated risks.
- Setting a minimum TAC does not alter mean catch or associated risk but increases the probability of closures.
- For the same risk level, expected catches are higher for the options where there is no upper TAC constraint (Fig.3.1.1.3).
- Both rules A & B imply similar risk at equal mean annual catch (fig.3.1.1.4). However, Rule B may result in higher stability in TACs.
- Results are not sensitive to the use of either the Ricker or the Quadratic Hockey stick stock and recruitment models.
- However there is high sensitivity to a low recruitment scenario. If a low recruitment scenario persisted then catches would be on average less than 10,000 t while the associated risk will be higher than 10% for all harvest strategies investigated.
- Two population models were implemented to test the HCR. The biomass model that forms the basis for ICES advice was implemented as the base case.
- There is uncertainty in the estimation of associated risk for each harvest rate, depending on the population and fishery model used. For the same harvest rate, the age-structured model estimates lower risk and catch. For the same expected catch, the age-structured model suggests lower risk.
- The difference in estimated risk between models may suggest a need for some flexibility in its interpretation. Levels of less than 5% are normally considered precautionary. However, given the uncertainty in the estimates of risk, harvest rates resulting in risk slightly higher than 5% according to the biomass model should be advanced for consideration.

4.2. Economic Model: main findings

- Overall discounted gross revenue is maximized when the harvest rate is increased. This is clearly so when a maximum TAC of 33.000 tonnes is set. This maximum TAC allows a better overall result compared to the cases where there is not such maximum.
- The highest overall discounted cash flow is maximized for low harvest rates but this could be a consequence of the "optimistic" expected availability of other species and that the price for them was kept constant. This "optimistic" way of doing the analysis is especially important for Spain given that it has not been possible to estimate a production function for other species by half year, which results in the alternatives in the first half year being over estimated.
- The highest overall discounted cash flow decreases with the harvest rate, but this decrease is more flat when a maximum TAC of 33000 tonnes is applied (cases b and d).
- The economic risk is much lower when a maximum TAC of 33000 tonnes is applied (cases b and d), and also the increase of risk is more flat in these two cases.
- The social indicator reflects the relationship between the average wage of the member state and those obtained by the fleets. Given that the number of vessels has been considered fixed, it only

reflects the social consequences in this scenario. If the number of vessels changes, the social consequences may also be different.

- Social consequences are not taking into consideration employment other than employment as crew on-board. Employment directly or indirectly linked to the fishing activity was not taken into account.
- Deterministic and stochastic runs perform similarly in terms of income, even if the price function may apply to values outside the observed range of TAC used for its estimation. This is especially true when there is no maximum TAC.
- Cost parameters as well as the production function for anchovy and other species were estimated, but further work should be done in this basis to refine the estimations.
- Evolution of cost is a key factor in the economic performance of the fleets, but even if in the simulations we have tried to use the last available data, they have remained constant for simulation purposes.
- There are factors which could not be considered in this analysis but are likely to have a great influence in the economic performance of the HCR. The anchovy processing industry (which represents the most important demand for these fleets) could change their purchasing patterns as they have done while the fishery was closed, changing dramatically the price function structure.
- This industry is asking for a well supplied market (high TAC) and low prices. In that sense low TACs create a risk to the fleets of loosing their buyers. But high TACs also increase the risk of closing the fishery, and discontinuity in the supply could also result in the processing industry turning to other markets.
- The effect of the allocation method of TAC into quota by countries on the national fleets was tested. Obviously the higher the allocation to Spain the lower the probability of negative cash flow for Spain and the higher for France. However, given the effect of switching to other species these changes may have a lesser impact than a priori suspected.

4.3. Limitations and scope for the application of the analysis performed by this STECF WG on Long-term management of anchovy

The validity of the results presented in the current report depends on the availability of the necessary data to fit the models and the validity of the assumptions made to complete the simulations and the analysis of the report. New information leading to reviewing inputs and assumptions would require revisiting the conclusions presented in the current report. The major relevant factors underpinning the validity of this report are listed below:

- The Biological modeling of the population is valid as far as the productivity of the stock does not change and remains well reflected in the stock recruitment relationships used for the simulations. The simulations and conclusions presented in this report should only be considered valid as long as the S/R parameters do not significantly vary in future from the ones used in this document. In case significant changes of the stock productivity took place, then the analysis presented in this report should be re-evaluated before using it again as basis for advice on the management of anchovy.
- The HCR are based on estimates of the absolute levels of biomass of the population and the reference points for management. If those change, then the Harvest control rules should be accordingly revised or reformulated, although in relative terms the impact on the long term expected catches is likely to be minimal.

- There is no interaction between the biological and the economic model (economic models are not included in the MSE loop). This would mean that fishing takes place irrespective of the economic performance between anchovy and other species.
- Total fishing effort is linked to the number of vessels which is fixed
- Economic data sets, especially DCR data, were available to the WG and for the the relevant fleet segments and this was considered as positive for the WG. However some data were missing such as capital cost, interest cost (for both fleets) and net profit indicator was not calculated. More detailed information on earnings, costs and employment per metier was not available for economic assessment. The lack of longer time series for the estimation of demand functions and production functions was also considered as a limitation.
- The economic and social impact has been restricted to the impact on the fleets. The impact associated to consumer's (processing industry, etc) and to in land employment through spillover effects has not been taken into account. The inclusion of the associated work in terms of consumer's welfare indicator would presumably tend to favor rules resulting in high catch (not necessarily the highest cash flow of the fleet). In any case the inclusion of these indicators may change substantially the assessed impacts of any harvest control rule.
- The harvest control rules tested assume that no recruitment index is available in autumn, before recruits of age 1 enter the fishery at the beginning of the year. Therefore the management calendar goes from July to June next year, based on the SSB estimates provided by the direct surveys in May. The likelihood that a recruitment index becomes available and operative in the next coming years is high. In that case the current analysis of potential HCRs should be expanded to include a recruitment index that would potentially help to improve the management of the stock. The recruitment index should be available for the formulation of management advice at the beginning of the year, leading to a management calendar from January to January with a revision (if necessary) at the middle of the year according to the spring direct surveys. A complete revision of the performance of these and other HCRs would be required in this new scenario for management.
- Other assumptions limiting the analysis: no assessment bias is taken into account although retrospective analyses suggest that the bias in the assessment is not significant (Fig 3, Appendix I). The set TAC is assumed caught (there are no implementation errors).

5. References

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6. Appendix I: Response to STECF Spring Plenary

After the presentation of the main findings from the first meeting on Long-term management plan for Bay of Biscay anchovy the STECF Plenary made two suggestions. The response of the STECF WG follows.

1)

"…in the HCRs which have been investigated by the WG, the TAC is set on the basis of the SSB at the start of the fishing season (1 July) and without prior knowledge of the size of the incoming year class (age 1, 1 January) which constitutes a major part of the catch in the spring (2nd half of the TAC year). STECF highlights that this could cause problems of a mismatch between TAC and catch rates if a large year-class were to occur following the implementation of a low TAC. STECF suggests that the WG should investigate the likelihood of this occurring. Time permitting, the likelihood of a high TAC when the stock is low would also be investigated."

In order to study the likelihood of mismatches between the set TAC and the TAC that would correspond to the actual stock level (optimal TAC), the distribution of the TAC difference (set TAC minus TAC optimal) have been analysed. Figures 1 and 2 show the median, 90% and 95% confidence intervals for the TAC difference in the first half year for Rule B case a (when there are no constrains on the TAC) and case d (when a maximum TAC of 33,000 tonnes and a minimum TAC of 7,000 tonnes are imposed) respectively. The larger the exploitation rate γ, the larger the TAC differences will be. The median TAC difference is zero, indicating that it is equally likely to have a set TAC larger than the optimal TAC than to have a lower set TAC. When no upper or lower TAC constrain is set the distribution of the TAC difference is symmetric around zero. However, when upper and lower constrains are established the distribution is not symmetric. Tables 1-4 summarize the probabilities of the TAC difference depending on the harvest rate for Rule B and cases a-d (no constrain, upper bound, lower bound, upper and lower bound) respectively.

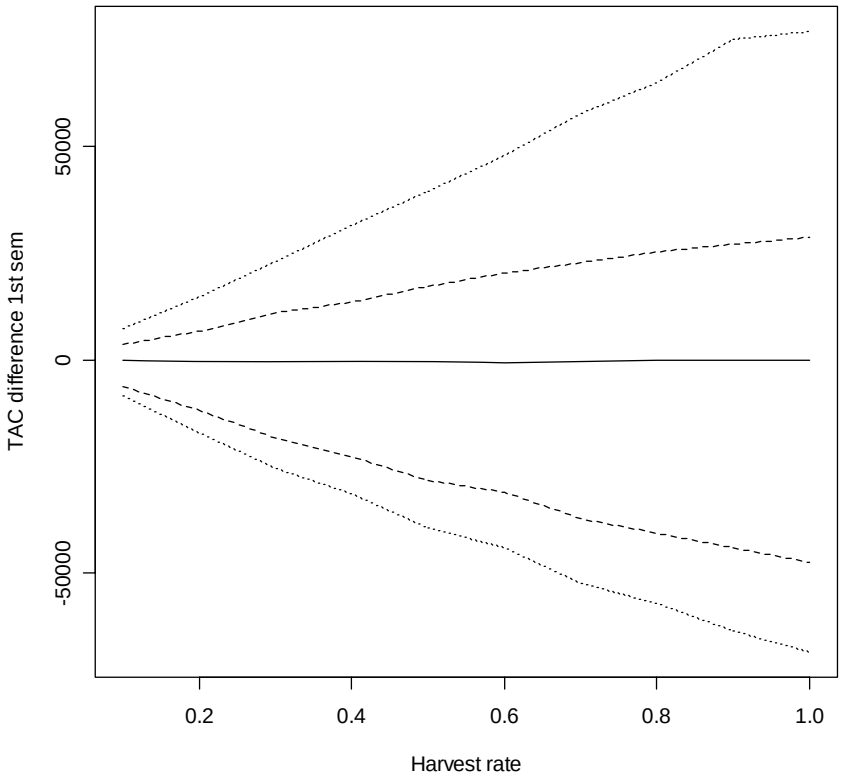

Figure 1: The median (solid line), 90% (dashed line) and 95% (dotted line) confidence intervals of TAC difference in the 1st half year depending on the harvest rate γ for Rule B case a (when there are no constrains on the TAC).

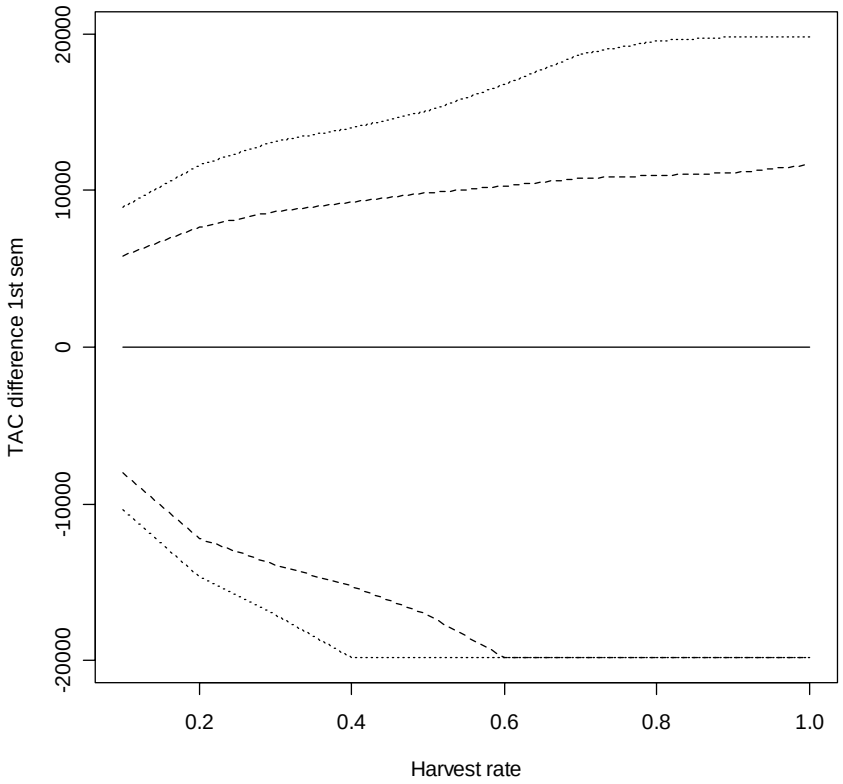

Figure 2: The median (solid line), 90% (dashed line) and 95% (dotted line) confidence intervals of TAC difference in the 1st half year depending on the harvest rate γ for Rule B case d (when a maximum TAC of 33,000 tonnes and a minimum TAC of 7,000 tonnes are imposed).

Table 1: Probability distribution for the difference in the 1st half year between the TAC and the TAC that would have been set in case the real SSB would have been known without any error depending on the harvest rate for Rule B case a (no constrains).

	$TAC - TAC_{opt}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Undershot	Less than -20,000	0.009	0.049	0.097	0.139	0.169	0.191	0.209	0.230	0.243	0.242
	Between -20,000 and -15,000	0.013	0.031	0.044	0.051	0.047	0.054	0.054	0.051	0.042	0.045
	Between -15,000 and -10,000	0.032	0.065	0.071	0.076	0.077	0.072	0.071	0.061	0.057	0.053
	Between -10,000 and -5,000	0.098	0.128	0.125	0.111	0.105	0.095	0.083	0.077	0.068	0.068
	Between -5,000 and 0	0.389	0.269	0.196	0.157	0.131	0.112	0.100	0.083	0.081	0.070
	0	0.010	0.013	0.014	0.019	0.038	0.052	0.076	0.103	0.132	0.170
Overshot	Between 0 and 5,000	0.329	0.220	0.156	0.130	0.113	0.094	0.076	0.071	0.064	0.051
	Between 5,000 and 10,000	0.082	0.107	0.106	0.090	0.076	0.071	0.065	0.055	0.045	0.042
	Between 10,000 and 15,000	0.024	0.054	0.064	0.065	0.061	0.052	0.050	0.045	0.037	0.033
	Between 15,000 and 20,000	0.008	0.027	0.040	0.045	0.039	0.040	0.039	0.037	0.033	0.027
	More than 20,000	0.007	0.037	0.086	0.116	0.146	0.167	0.177	0.188	0.198	0.199

Table 2: Probability distribution for the difference in the 1st half of the year between the TAC and the TAC that would have been set in case the real SSB would have been known without any error depending on the harvest rate for Rule B case b (upper limit 33,000t).

	$TAC - TAC_{opt}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Undershot	Less than -20,000	0.013	0.041	0.069	0.090	0.102	0.112	0.129	0.135	0.138	0.149
	Between -20,000 and -15,000	0.013	0.037	0.052	0.058	0.059	0.061	0.055	0.054	0.051	0.050
	Between -15,000 and -10,000	0.030	0.059	0.080	0.082	0.082	0.081	0.074	0.070	0.068	0.063
	Between -10,000 and -5,000	0.095	0.134	0.130	0.122	0.107	0.094	0.087	0.082	0.074	0.071
	Between -5,000 and 0	0.390	0.262	0.194	0.156	0.141	0.112	0.101	0.089	0.080	0.072
	0	0.011	0.013	0.039	0.073	0.122	0.166	0.211	0.235	0.275	0.291
Overshot	Between 0 and 5,000	0.323	0.227	0.167	0.142	0.119	0.102	0.088	0.080	0.071	0.068
	Between 5,000 and 10,000	0.086	0.118	0.116	0.102	0.094	0.089	0.074	0.073	0.065	0.058
	Between 10,000 and 15,000	0.024	0.062	0.075	0.080	0.071	0.070	0.062	0.059	0.051	0.051
	Between 15,000 and 20,000	0.011	0.034	0.049	0.052	0.051	0.052	0.050	0.047	0.045	0.042
	More than 20,000	0.004	0.013	0.029	0.044	0.054	0.062	0.069	0.076	0.082	0.087

Table 3: Probability distribution for the difference in the 1st half of the year between the TAC and the TAC that would have been set in case the real SSB would have been known without any error depending on the harvest rate for Rule B case c (lower limit 7,000t).

	$TAC - TAC_{opt}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Undershot	Less than -20,000	0.017	0.057	0.109	0.153	0.187	0.208	0.226	0.233	0.247	0.250
	Between -20,000 and -15,000	0.021	0.043	0.057	0.055	0.056	0.056	0.053	0.051	0.047	0.044
	Between -15,000 and -10,000	0.059	0.088	0.090	0.087	0.080	0.073	0.071	0.064	0.057	0.057
	Between -10,000 and -5,000	0.097	0.105	0.100	0.091	0.086	0.069	0.059	0.055	0.055	0.045
	Between -5,000 and 0	0.043	0.081	0.076	0.064	0.057	0.046	0.035	0.035	0.027	0.025
	0	0.501	0.260	0.166	0.152	0.140	0.163	0.180	0.198	0.222	0.254
Overshot	Between 0 and 5,000	0.057	0.094	0.080	0.064	0.055	0.047	0.041	0.035	0.027	0.021
	Between 5,000 and 10,000	0.111	0.109	0.100	0.082	0.067	0.060	0.052	0.046	0.041	0.031
	Between 10,000 and 15,000	0.063	0.081	0.080	0.075	0.066	0.056	0.055	0.045	0.042	0.039
	Between 15,000 and 20,000	0.020	0.038	0.053	0.050	0.047	0.043	0.042	0.039	0.036	0.033
	More than 20,000	0.010	0.045	0.090	0.128	0.158	0.179	0.187	0.199	0.200	0.203

Table 4: Probability distribution for the difference in the 1st half of the year between the TAC and the TAC that would have been set in case the real SSB would have been known without any error depending on the harvest rate for Rule B case d (upper limit 33,000t and lower limit 7,000t).

	TAC - TAC_{opt}	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Undershot	Less than -20,000	0.017	0.053	0.079	0.103	0.115	0.126	0.139	0.147	0.152	0.159
	Between -20,000 and -15,000	0.020	0.047	0.061	0.066	0.069	0.064	0.063	0.057	0.054	0.053
	Between -15,000 and -10,000	0.060	0.089	0.095	0.092	0.087	0.077	0.069	0.071	0.061	0.058
	Between -10,000 and -5,000	0.097	0.113	0.102	0.100	0.085	0.080	0.072	0.065	0.055	0.054
	Between -5,000 and 0	0.047	0.083	0.076	0.066	0.059	0.051	0.051	0.042	0.040	0.037
	0	0.496	0.246	0.199	0.194	0.221	0.265	0.278	0.310	0.343	0.360
Overshot	Between 0 and 5,000	0.058	0.096	0.092	0.089	0.079	0.065	0.059	0.053	0.048	0.039
	Between 5,000 and 10,000	0.115	0.117	0.110	0.097	0.084	0.077	0.075	0.061	0.051	0.049
	Between 10,000 and 15,000	0.066	0.090	0.093	0.089	0.080	0.068	0.064	0.062	0.058	0.051
	Between 15,000 and 20,000	0.018	0.046	0.054	0.056	0.057	0.055	0.051	0.048	0.050	0.046
	More than 20,000	0.006	0.022	0.039	0.050	0.064	0.072	0.080	0.085	0.087	0.094

2)

"*As a general comment to the simulations tests of the HCR, STECF repeats its previous advice that the assessment model used in the HCR simulations should be the same as the assessment model that is used to derive the management advice. In addition, the WG verified the results from the biomass operating model by using an age-structured model. STECF notes that for the case of Bay of Biscay anchovy, the model currently used to provide advice to managers is a Bayesian model, which prevents its use in the HCR simulations because of too great a computational burden for the time available to the group. STECF suggests that one way to simulate the dependencies between the HCR simulation results and the Bayesian assessment accuracy, would be for the WG to use the estimates of bias from previous Bayesian stock assessments. STECF suggests that given autocorrelation in the residuals in the biomass assessment that is taken into account in the simulations.*"

The Bay of Biscay anchovy stock is assessed by a Bayesian biomass-based model (BBM) implemented using Markov chain Monte Carlo (MCMC) methods. Given the computational burden needed to run the assessment, the assessment has not been included in the management strategy evaluation (MSE) loop. Instead, the assessment error has been included together with the observation error from the surveys. The observed SSB, which is used to set the TAC, has been taken as a log-normal distribution with mean given by the true population SSB and a constant CV of 25%. This implies that the observed SSB, is assumed to be unbiased. In order to analyse to which extend this assumption may be too strong a retrospective analysis was conducted for the BBM. Figure 3 shows the medians (solid lines) of the retrospective SSB time-series for the years 1987 to 2007. The red bullets correspond to the median SSB in the assessment year. The 95% credible intervals (dashed lines) correspond to the 2007 SSB estimates. In general there is no bias in the assessment except in 2000. This year the SSB estimates from the DEPM and the acoustic surveys were very different from each other. Since the BBM takes the DEPM as absolute the assessment favoured the DEPM SSB estimate, which was proved to be biased by the following year surveys and landings.

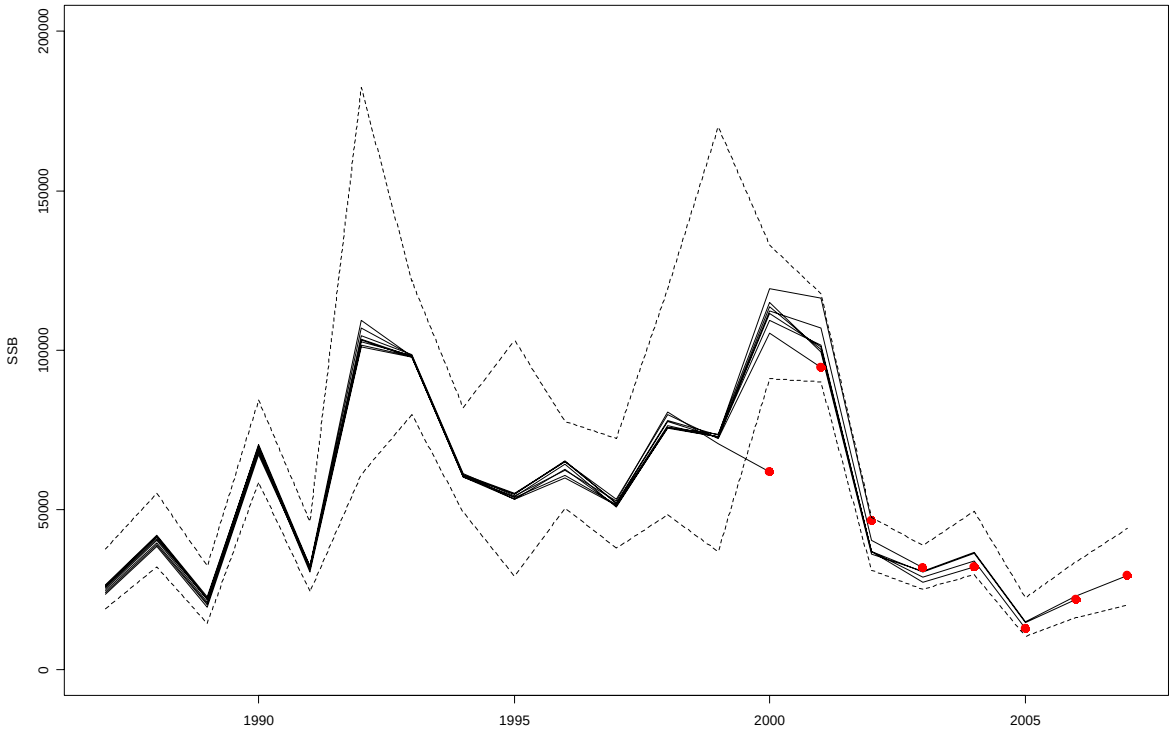

Figure 3: Retrospective analysis for the BBM. Solid lines represent the SSB medians for each annual assessment. The red solid circles are the SSB median from the last year of each annual assessment. The dashed lines represent the 95% credible intervals for the assessment in 2007.

7. Appendix II: Summary results of the evaluation of the proposed HCRs using the biomass based model

HCR	Allocat. % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years SSB<B_{lim}	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch	Aver catch Spain	Aver catch France
Rule A	cte	ticker	0.1	no	no	77638	81911	0.009	0.055	0.065	0.063	0.021	0.157	0.212	6762	5081	1.074	3381	3381
Rule A	cte	ticker	0.2	no	no	68298	70772	0.017	0.115	0.165	0.154	0.029	0.205	0.287	12049	9829	2.362	6025	6025
Rule A	cte	ticker	0.3	no	no	60327	61085	0.029	0.186	0.289	0.272	0.047	0.303	0.485	16057	14640	2.805	8028	8028
Rule A	cte	ticker	0.4	no	no	55165	55529	0.052	0.293	0.517	0.468	0.066	0.402	0.693	18866	18075	4.365	9499	9499
Rule A	cte	ticker	0.5	no	no	50918	48509	0.082	0.446	0.824	0.719	0.102	0.552	1.018	22250	22847	3.452	11101	11129
Rule A	cte	ticker	0.6	no	no	44644	44332	0.137	0.631	1.372	1.132	0.146	0.698	1.480	23193	25740	3.792	11555	11638
Rule A	cte	ticker	0.7	no	no	41508	39855	0.174	0.722	1.743	1.381	0.179	0.765	1.787	24845	28998	9.410	12319	12527
Rule A	cte	ticker	0.8	no	no	36182	35567	0.236	0.819	2.356	1.749	0.230	0.854	2.286	24365	30160	4.921	11937	12228
Rule A	cte	ticker	0.9	no	no	33513	32033	0.290	0.890	2.931	2.120	0.278	0.913	2.777	24592	31107	5.884	11995	12596
Rule A	cte	ticker	1	no	no	30245	28303	0.331	0.932	3.305	2.288	0.315	0.935	3.148	24654	32952	4.146	12035	12619
Rule A	cte	ticker	0.1	33000	no	74904	80288	0.010	0.088	0.096	0.094	0.023	0.173	0.228	6416	4745	3.314	3208	3208
Rule A	cte	ticker	0.2	33000	no	69391	70858	0.013	0.090	0.128	0.122	0.029	0.216	0.284	11313	7935	2.124	5656	5656
Rule A	cte	ticker	0.3	33000	no	62399	64181	0.026	0.178	0.255	0.240	0.042	0.293	0.417	14294	9817	3.268	7147	7147
Rule A	cte	ticker	0.4	33000	no	58636	60222	0.043	0.252	0.426	0.386	0.060	0.371	0.599	16241	10583	NA	8121	8121
Rule A	cte	ticker	0.5	33000	no	56056	56348	0.058	0.337	0.584	0.502	0.073	0.432	0.730	17684	11032	2.311	8842	8842
Rule A	cte	ticker	0.6	33000	no	53393	53779	0.075	0.422	0.746	0.622	0.087	0.500	0.873	18747	11532	3.014	9373	9373
Rule A	cte	ticker	0.7	33000	no	50825	49222	0.093	0.475	0.931	0.749	0.104	0.552	1.039	19106	11625	3.418	9553	9553
Rule A	cte	ticker	0.8	33000	no	48716	47828	0.113	0.548	1.130	0.915	0.122	0.627	1.224	19675	11829	4.655	9837	9838
Rule A	cte	ticker	0.9	33000	no	47661	47818	0.132	0.580	1.320	0.992	0.138	0.640	1.380	20242	11945	2.717	10120	10122
Rule A	cte	ticker	1	33000	no	46231	45572	0.141	0.614	1.411	1.088	0.146	0.657	1.459	20896	11885	5.859	10446	10451
Rule A	cte	ticker	0.1	no	7000	76540	84388	0.008	0.057	0.082	0.079	0.635	0.999	6.351	4622	6339	NA	2311	2311
Rule A	cte	ticker	0.2	no	7000	70430	73316	0.007	0.055	0.073	0.071	0.377	0.981	3.772	10960	11224	NA	5480	5480
Rule A	cte	ticker	0.3	no	7000	62502	63224	0.021	0.134	0.213	0.195	0.302	0.942	3.022	15537	15585	NA	7769	7769
Rule A	cte	ticker	0.4	no	7000	55845	58574	0.040	0.248	0.396	0.358	0.289	0.922	2.888	18850	19285	0.966	9424	9426
Rule A	cte	ticker	0.5	no	7000	50971	48899	0.075	0.408	0.751	0.643	0.292	0.928	2.920	21733	23880	1.093	10845	10888
Rule A	cte	ticker	0.6	no	7000	45011	43466	0.131	0.603	1.314	1.101	0.323	0.942	3.234	22743	26451	1.178	11312	11431
Rule A	cte	ticker	0.7	no	7000	40717	38374	0.172	0.710	1.716	1.335	0.346	0.967	3.455	23619	28816	NA	11788	12030
Rule A	cte	ticker	0.8	no	7000	37192	37158	0.224	0.819	2.239	1.719	0.368	0.980	3.684	24249	30808	1.214	11925	12323
Rule A	cte	ticker	0.9	no	7000	34080	31354	0.274	0.882	2.739	1.945	0.391	0.980	3.911	24954	32187	1.248	12205	12749
Rule A	cte	ticker	1	no	7000	30660	27877	0.337	0.925	3.373	2.398	0.435	0.987	4.345	24701	34085	1.328	11946	12755
Rule A	cte	ticker	0.1	33000	7000	79115	80138	0.007	0.052	0.072	0.071	0.627	1.000	6.274	4599	6052	NA	2300	2300
Rule A	cte	ticker	0.2	33000	7000	70341	72841	0.010	0.070	0.096	0.096	0.372	0.967	3.722	10347	9331	NA	5173	5173
Rule A	cte	ticker	0.3	33000	7000	63950	65855	0.019	0.123	0.190	0.181	0.296	0.926	2.964	13460	10729	NA	6740	6740
Rule A	cte	ticker	0.4	33000	7000	59176	61434	0.032	0.211	0.322	0.299	0.262	0.893	2.623	15716	11462	0.838	7859	7859
Rule A	cte	ticker	0.5	33000	7000	56551	58776	0.049	0.295	0.494	0.429	0.247	0.880	2.468	17250	11822	0.824	8625	8625
Rule A	cte	ticker	0.6	33000	7000	54613	56767	0.066	0.378	0.656	0.564	0.242	0.877	2.415	18333	12051	NA	9166	9167
Rule A	cte	ticker	0.7	33000	7000	51836	53738	0.083	0.454	0.833	0.721	0.246	0.881	2.460	18907	12414	0.566	9453	9454
Rule A	cte	ticker	0.8	33000	7000	49747	48437	0.107	0.535	1.069	0.863	0.241	0.879	2.408	19591	12487	0.548	9795	9796
Rule A	cte	ticker	0.9	33000	7000	48552	47285	0.119	0.553	1.191	0.945	0.242	0.848	2.417	20040	12351	0.540	10019	10022
Rule A	cte	ticker	1	33000	7000	47755	47709	0.143	0.618	1.427	1.142	0.242	0.857	2.424	20437	12481	0.522	10216	10221

HCR	Allocat % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years SSB<B_{lim}	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interanual catch variation	Aver catch Spain	Aver catch France
Rule A	var	ticker	0.1	no	no	75025	85428	0.010	0.084	0.104	0.097	0.021	0.150	0.211	6969	5038	1.846	5236	1332
Rule A	var	ticker	0.2	no	no	66766	67855	0.016	0.109	0.158	0.150	0.032	0.220	0.319	11683	9733	1.941	8594	3089
Rule A	var	ticker	0.3	no	no	60653	60017	0.034	0.208	0.337	0.305	0.050	0.313	0.488	15669	13742	2.887	11017	4652
Rule A	var	ticker	0.4	no	no	54339	53851	0.054	0.323	0.541	0.490	0.070	0.433	0.698	19547	19433	7.024	13317	6230
Rule A	var	ticker	0.5	no	no	49565	49303	0.066	0.448	0.858	0.753	0.098	0.548	0.980	21715	22468	3.193	14575	7140
Rule A	var	ticker	0.6	no	no	43622	43267	0.140	0.842	1.397	1.157	0.149	0.712	1.487	23056	25888	4.561	15267	7791
Rule A	var	ticker	0.7	no	no	39858	39458	0.164	0.734	1.837	1.491	0.183	0.783	1.833	23906	27980	16.256	15692	8218
Rule A	var	ticker	0.8	no	no	36268	35725	0.242	0.842	2.415	1.799	0.241	0.864	2.455	24431	29850	5.167	15825	8606
Rule A	var	ticker	0.9	no	no	33066	32677	0.295	0.888	2.930	2.071	0.278	0.880	2.777	24804	31487	5.691	15868	8858
Rule A	var	ticker	1	no	no	31063	29508	0.322	0.919	3.222	2.245	0.304	0.935	3.041	24966	32945	4.758	15858	9140
Rule A	var	ticker	0.1	33000	no	76337	80284	0.010	0.076	0.104	0.101	0.025	0.178	0.253	6511	4873	2.686	5199	1311
Rule A	var	ticker	0.2	33000	no	66643	70752	0.016	0.110	0.162	0.152	0.031	0.220	0.312	11272	7947	2.292	8337	2934
Rule A	var	ticker	0.3	33000	no	62195	65045	0.029	0.183	0.288	0.263	0.045	0.265	0.452	14113	9592	2.151	10018	4096
Rule A	var	ticker	0.4	33000	no	56715	57785	0.039	0.230	0.388	0.353	0.059	0.360	0.588	16501	10532	2.227	11385	5116
Rule A	var	ticker	0.5	33000	no	55043	57936	0.057	0.342	0.568	0.495	0.073	0.445	0.733	17612	10958	2.116	12105	5708
Rule A	var	ticker	0.6	33000	no	53956	53287	0.077	0.414	0.768	0.651	0.092	0.494	0.923	18799	11348	2.935	12620	6179
Rule A	var	ticker	0.7	33000	no	52053	51388	0.100	0.513	0.999	0.835	0.107	0.566	1.068	19402	11671	3.333	12916	6486
Rule A	var	ticker	0.8	33000	no	49367	50459	0.125	0.582	1.250	0.994	0.126	0.609	1.257	19679	11781	6.127	13033	6646
Rule A	var	ticker	0.9	33000	no	46642	48878	0.136	0.601	1.361	1.067	0.139	0.655	1.386	20290	11983	2.233	13345	6945
Rule A	var	ticker	1	33000	no	47442	47761	0.143	0.621	1.432	1.112	0.150	0.662	1.497	20421	12232	2.455	13392	7029
Rule A	var	ticker	0.1	no	7000	80259	85283	0.008	0.051	0.075	0.074	0.024	1.000	6.238	4600	6558	NA	3859	1141
Rule A	var	ticker	0.2	no	7000	70258	74885	0.009	0.058	0.087	0.081	0.373	0.963	3.728	11100	11376	NA	7955	3145
Rule A	var	ticker	0.3	no	7000	62267	64438	0.019	0.134	0.192	0.176	0.309	0.942	3.089	15450	15735	NA	10657	4793
Rule A	var	ticker	0.4	no	7000	56332	57477	0.042	0.244	0.422	0.382	0.285	0.933	2.849	18720	19174	0.964	12632	6087
Rule A	var	ticker	0.5	no	7000	51269	50884	0.075	0.408	0.753	0.664	0.287	0.923	2.865	21655	23370	1.063	14378	7277
Rule A	var	ticker	0.6	no	7000	46221	44192	0.116	0.585	1.155	1.011	0.302	0.944	3.024	23552	26548	1.117	15454	8098
Rule A	var	ticker	0.7	no	7000	40428	39282	0.178	0.751	1.783	1.442	0.353	0.973	3.527	23511	28782	NA	15273	8238
Rule A	var	ticker	0.8	no	7000	37620	35443	0.226	0.797	2.257	1.687	0.368	0.978	3.683	24690	30579	1.234	15900	8790
Rule A	var	ticker	0.9	no	7000	33368	31549	0.285	0.872	2.849	2.114	0.408	0.983	4.082	24829	32747	1.328	15746	9083
Rule A	var	ticker	1	no	7000	30415	28424	0.336	0.927	3.383	2.348	0.434	0.994	4.337	24919	33988	NA	15611	9308
Rule A	var	ticker	0.1	33000	7000	79027	85203	0.009	0.054	0.087	0.081	0.031	0.999	6.311	4596	6182	NA	3518	1078
Rule A	var	ticker	0.2	33000	7000	70361	74078	0.011	0.070	0.105	0.102	0.378	0.963	3.782	10102	9271	NA	7317	2785
Rule A	var	ticker	0.3	33000	7000	64615	67256	0.015	0.101	0.154	0.142	0.289	0.919	2.889	13923	10800	NA	9683	4240
Rule A	var	ticker	0.4	33000	7000	59308	60285	0.036	0.215	0.355	0.324	0.271	0.894	2.714	15559	11480	NA	10625	4804
Rule A	var	ticker	0.5	33000	7000	56570	56598	0.049	0.303	0.491	0.440	0.243	0.877	2.434	17366	11949	0.615	11684	5684
Rule A	var	ticker	0.6	33000	7000	53916	53885	0.074	0.389	0.740	0.651	0.239	0.875	2.391	18342	12127	0.585	12216	6126
Rule A	var	ticker	0.7	33000	7000	51191	49826	0.090	0.451	0.901	0.783	0.244	0.868	2.439	18926	12300	NA	12513	6413
Rule A	var	ticker	0.8	33000	7000	50626	49800	0.107	0.527	1.068	0.882	0.243	0.854	2.428	19652	12404	0.546	12904	6748
Rule A	var	ticker	0.9	33000	7000	49460	49233	0.120	0.573	1.201	0.969	0.243	0.857	2.427	20146	12488	0.521	13173	6975
Rule A	var	ticker	1	33000	7000	47305	46415	0.149	0.627	1.491	1.152	0.260	0.862	2.597	20140	12655	0.506	13109	7030

HCR	Allocat % Spain	SR	HR	TAC_{min}	TAC_{max}	Median SSB	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years SSB<B_{lim}	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule A	0.9	ricker	0.1	no	no	76120	81558	0.009	0.080	0.092	0.089	0.022	0.182	0.220	6526	4944	1.660	4509	1958
Rule A	0.9	ricker	0.2	no	no	67626	72393	0.021	0.128	0.207	0.186	0.036	0.229	0.358	11795	9705	2.362	8257	3539
Rule A	0.9	ricker	0.3	no	no	61780	62402	0.025	0.163	0.250	0.229	0.043	0.288	0.428	16166	14370	2.484	11332	4857
Rule A	0.9	ricker	0.4	no	no	56570	57480	0.053	0.308	0.526	0.469	0.070	0.426	0.697	19482	18810	3.104	13636	5847
Rule A	0.9	ricker	0.5	no	no	49851	48385	0.092	0.478	0.920	0.817	0.103	0.555	1.034	21696	22059	3.752	15178	6519
Rule A	0.9	ricker	0.6	no	no	44266	43881	0.137	0.628	1.368	1.093	0.144	0.684	1.436	22565	25837	5.752	16043	6862
Rule A	0.9	ricker	0.7	no	no	40515	38018	0.186	0.754	1.878	1.475	0.186	0.779	1.881	24965	28827	5.257	17364	7501
Rule A	0.9	ricker	0.8	no	no	36734	35930	0.236	0.815	2.361	1.786	0.233	0.853	2.328	24360	29735	4.374	16839	7521
Rule A	0.9	ricker	0.9	no	no	33923	32097	0.282	0.875	2.824	2.032	0.273	0.906	2.734	25042	31407	14.623	17257	7785
Rule A	0.9	ricker	1	no	no	29603	27880	0.350	0.855	3.501	2.466	0.330	0.955	3.302	24461	32224	4.888	16734	7747
Rule A	0.9	ricker	0.1	35000	no	77323	81122	0.010	0.070	0.096	0.088	0.024	0.170	0.237	6644	4923	4.495	4651	1993
Rule A	0.9	ricker	0.2	35000	no	69777	71754	0.013	0.085	0.132	0.127	0.029	0.210	0.293	11276	7921	2.136	7894	3383
Rule A	0.9	ricker	0.3	35000	no	64762	65039	0.024	0.155	0.244	0.229	0.040	0.272	0.397	14765	9803	1.859	10349	4435
Rule A	0.9	ricker	0.4	35000	no	60762	57773	0.040	0.248	0.399	0.355	0.054	0.342	0.537	16693	10590	2.053	11825	5066
Rule A	0.9	ricker	0.5	35000	no	57242	58936	0.057	0.334	0.568	0.509	0.078	0.464	0.781	18053	11088	NA	12637	5416
Rule A	0.9	ricker	0.6	35000	no	55965	56293	0.069	0.391	0.687	0.598	0.083	0.476	0.828	19049	11203	4.053	13346	5805
Rule A	0.9	ricker	0.7	35000	no	52945	54458	0.091	0.461	0.908	0.758	0.107	0.556	1.085	19643	11598	10.323	13749	5894
Rule A	0.9	ricker	0.8	35000	no	46908	50889	0.125	0.583	1.249	1.024	0.133	0.631	1.332	19468	12018	4.789	13639	5849
Rule A	0.9	ricker	0.9	35000	no	50699	50745	0.125	0.577	1.251	1.044	0.133	0.621	1.333	20654	11833	2.303	14453	6201
Rule A	0.9	ricker	1	35000	no	47871	48830	0.136	0.615	1.377	1.087	0.143	0.690	1.431	20668	12038	2.143	14477	6210
Rule A	0.9	ricker	0.1	no	7000	78631	80831	0.009	0.081	0.087	0.086	0.035	0.999	6.345	4632	6323	NA	3242	1390
Rule A	0.9	ricker	0.2	no	7000	69973	70970	0.010	0.081	0.096	0.090	0.375	0.976	3.748	10916	11084	NA	7640	3276
Rule A	0.9	ricker	0.3	no	7000	62667	66162	0.021	0.145	0.205	0.200	0.308	0.934	3.083	15276	15085	0.849	10695	4583
Rule A	0.9	ricker	0.4	no	7000	55249	58882	0.045	0.271	0.448	0.417	0.295	0.927	2.948	18360	19120	0.973	12854	5510
Rule A	0.9	ricker	0.5	no	7000	49690	48530	0.076	0.421	0.763	0.673	0.295	0.941	2.948	21449	23552	1.060	15000	6449
Rule A	0.9	ricker	0.6	no	7000	44990	42888	0.121	0.575	1.208	1.024	0.320	0.956	3.199	22586	25744	NA	15738	6818
Rule A	0.9	ricker	0.7	no	7000	41469	39346	0.179	0.730	1.792	1.403	0.335	0.958	3.350	23968	27903	NA	16674	7294
Rule A	0.9	ricker	0.8	no	7000	37588	37147	0.226	0.797	2.279	1.743	0.369	0.977	3.685	24620	30584	1.223	17037	7583
Rule A	0.9	ricker	0.9	no	7000	34017	32128	0.279	0.885	2.785	2.077	0.399	0.983	3.987	24746	31602	1.256	17033	7714
Rule A	0.9	ricker	1	no	7000	30596	28234	0.334	0.917	3.335	2.335	0.440	0.989	4.398	24457	33059	1.302	16998	7759
Rule A	0.9	ricker	0.1	35000	7000	78566	85288	0.009	0.081	0.091	0.087	0.632	1.000	6.317	4554	6109	NA	3188	1366
Rule A	0.9	ricker	0.2	35000	7000	71162	73560	0.007	0.053	0.071	0.065	0.367	0.972	3.667	10364	9373	NA	7255	3109
Rule A	0.9	ricker	0.3	35000	7000	64273	66103	0.016	0.120	0.162	0.165	0.294	0.927	2.944	13652	10879	0.659	9557	4096
Rule A	0.9	ricker	0.4	35000	7000	60491	61240	0.032	0.205	0.319	0.294	0.256	0.896	2.563	16014	11481	NA	11210	4804
Rule A	0.9	ricker	0.5	35000	7000	56623	58940	0.054	0.307	0.540	0.469	0.251	0.878	2.512	17110	11855	0.610	11977	5133
Rule A	0.9	ricker	0.6	35000	7000	54792	54416	0.066	0.359	0.660	0.568	0.235	0.851	2.353	16554	12024	0.580	12987	5566
Rule A	0.9	ricker	0.7	35000	7000	52296	50803	0.094	0.484	0.937	0.774	0.242	0.845	2.415	19179	12315	0.559	13425	5754
Rule A	0.9	ricker	0.8	35000	7000	50699	50808	0.106	0.523	1.061	0.900	0.247	0.873	2.468	19496	12414	0.543	13648	5850
Rule A	0.9	ricker	0.9	35000	7000	48148	47537	0.130	0.581	1.304	1.032	0.253	0.872	2.527	19712	12485	0.538	13797	5915
Rule A	0.9	ricker	1	35000	7000	46961	46135	0.146	0.641	1.456	1.143	0.255	0.890	2.552	20072	12602	NA	14048	6024

HCR	Allocat. % Spain	SR	HR	TAC_{sau}	TAC_{sen}	Median SSB	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years $SSB<B_{lim}$	Nb years to $SSB>B_{lim}$	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule A	0.8	ricker	0.1	no	no	76321	83245	0.008	0.057	0.081	0.080	0.022	0.171	0.218	9669	5133	3.129	5335	1334
Rule A	0.8	ricker	0.2	no	no	69075	71558	0.013	0.084	0.133	0.126	0.030	0.213	0.303	11947	9823	2.158	9557	2389
Rule A	0.8	ricker	0.3	no	no	60304	61473	0.029	0.161	0.283	0.259	0.047	0.308	0.468	15629	13971	2.492	12993	3186
Rule A	0.8	ricker	0.4	no	no	54692	55570	0.062	0.343	0.615	0.539	0.074	0.426	0.738	18667	17948	4.129	15291	3776
Rule A	0.8	ricker	0.5	no	no	49649	50154	0.094	0.446	0.838	0.723	0.101	0.566	1.013	21711	22180	3.497	17353	4358
Rule A	0.8	ricker	0.6	no	no	44180	42350	0.146	0.629	1.455	1.183	0.152	0.699	1.515	22552	25532	7.917	18269	4613
Rule A	0.8	ricker	0.7	no	no	40524	38725	0.184	0.731	1.835	1.434	0.184	0.773	1.844	24266	28013	4.283	19341	4838
Rule A	0.8	ricker	0.8	no	no	36525	35534	0.244	0.830	2.442	1.777	0.235	0.865	2.351	25564	29032	3.835	19948	4946
Rule A	0.8	ricker	0.9	no	no	33388	32288	0.287	0.888	2.874	2.085	0.278	0.916	2.781	24910	31424	4.824	19683	5227
Rule A	0.8	ricker	1	no	no	30155	27302	0.349	0.926	3.485	2.345	0.322	0.934	3.218	24726	31884	3.802	19460	5266
Rule A	0.8	ricker	0.1	30000	no	75578	77191	0.011	0.080	0.112	0.103	0.024	0.170	0.235	6569	4988	2.546	5271	1318
Rule A	0.8	ricker	0.2	30000	no	68873	72111	0.015	0.092	0.153	0.140	0.030	0.210	0.300	11231	7989	7.387	8985	2246
Rule A	0.8	ricker	0.3	30000	no	62379	66108	0.026	0.163	0.263	0.249	0.044	0.294	0.440	14144	9891	2.487	11315	2829
Rule A	0.8	ricker	0.4	30000	no	56220	61028	0.040	0.244	0.395	0.360	0.058	0.380	0.583	16079	10448	2.891	12864	3216
Rule A	0.8	ricker	0.5	30000	no	54871	55108	0.065	0.352	0.652	0.567	0.084	0.479	0.840	17376	11004	2.848	13901	3475
Rule A	0.8	ricker	0.6	30000	no	52660	51522	0.086	0.444	0.860	0.727	0.096	0.535	0.959	18495	11441	2.706	14796	3699
Rule A	0.8	ricker	0.7	30000	no	51007	53223	0.097	0.488	0.969	0.797	0.109	0.580	1.085	19132	11784	31.465	15305	3827
Rule A	0.8	ricker	0.8	30000	no	46056	48333	0.125	0.585	1.250	1.014	0.132	0.632	1.317	19098	11985	1.962	15517	3881
Rule A	0.8	ricker	0.9	30000	no	47328	44273	0.147	0.621	1.470	1.121	0.147	0.665	1.469	19660	12125	9.475	15893	4000
Rule A	0.8	ricker	1	30000	no	46665	47048	0.158	0.638	1.582	1.197	0.161	0.674	1.613	20006	12089	2.383	16164	4045
Rule A	0.8	ricker	0.1	no	7000	80220	84038	0.006	0.038	0.068	0.055	0.625	1.000	6.251	4689	6284	NA	3752	938
Rule A	0.8	ricker	0.2	no	7000	69842	72157	0.011	0.072	0.113	0.106	0.377	0.970	3.765	10672	11083	NA	8538	2174
Rule A	0.8	ricker	0.3	no	7000	63197	64207	0.017	0.115	0.173	0.164	0.300	0.940	3.001	15516	15844	NA	12412	3103
Rule A	0.8	ricker	0.4	no	7000	56175	58709	0.043	0.240	0.427	0.388	0.269	0.923	2.694	18524	18529	0.927	14820	3656
Rule A	0.8	ricker	0.5	no	7000	50349	47579	0.093	0.442	0.830	0.726	0.262	0.933	2.615	21332	23102	NA	17052	4270
Rule A	0.8	ricker	0.6	no	7000	44948	43840	0.127	0.592	1.273	1.071	0.322	0.949	3.218	22144	25234	1.124	17678	4466
Rule A	0.8	ricker	0.7	no	7000	41306	39509	0.182	0.703	1.819	1.473	0.336	0.962	3.360	24369	29007	1.183	19491	4860
Rule A	0.8	ricker	0.8	no	7000	37583	34823	0.223	0.781	2.232	1.877	0.388	0.972	3.881	24112	29382	1.108	19143	4969
Rule A	0.8	ricker	0.9	no	7000	33737	32380	0.288	0.880	2.883	2.028	0.465	0.989	4.654	24235	31685	1.238	19222	5113
Rule A	0.8	ricker	1	no	7000	31026	30426	0.330	0.918	3.303	2.372	0.434	0.989	4.343	24216	32823	1.275	19051	5165
Rule A	0.8	ricker	0.1	30000	7000	79258	82889	0.005	0.035	0.050	0.048	0.626	1.000	6.257	4583	6072	NA	3666	917
Rule A	0.8	ricker	0.2	30000	7000	69655	71589	0.012	0.070	0.121	0.101	0.384	0.963	3.843	10172	9288	NA	8138	2034
Rule A	0.8	ricker	0.3	30000	7000	64563	66378	0.017	0.120	0.169	0.153	0.297	0.925	2.972	13626	10748	NA	10901	2725
Rule A	0.8	ricker	0.4	30000	7000	56568	60834	0.029	0.193	0.290	0.259	0.264	0.898	2.640	15670	11395	NA	12536	3134
Rule A	0.8	ricker	0.5	30000	7000	56795	57735	0.048	0.283	0.476	0.424	0.245	0.890	2.447	17362	11818	0.600	13906	3476
Rule A	0.8	ricker	0.6	30000	7000	54676	53347	0.068	0.377	0.676	0.588	0.237	0.899	2.374	18665	12075	NA	14932	3721
Rule A	0.8	ricker	0.7	30000	7000	51655	50891	0.094	0.457	0.937	0.790	0.252	0.874	2.519	18729	12411	0.576	14983	3747
Rule A	0.8	ricker	0.8	30000	7000	49498	48928	0.119	0.555	1.186	0.988	0.250	0.885	2.503	19046	12551	0.551	15475	3871
Rule A	0.8	ricker	0.9	30000	7000	46927	47752	0.129	0.571	1.285	1.005	0.250	0.890	2.489	19065	12585	0.528	15891	3974
Rule A	0.8	ricker	1	30000	7000	47535	47339	0.146	0.623	1.460	1.131	0.251	0.886	2.513	20026	12673	0.505	16260	4066

HCR	Allocat % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB	Median SSB_{min}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years $SSB<B_{lim}$	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule A	0.7	ticker	0.1	no	no	76030	61876	0.008	0.083	0.083	0.079	0.021	0.154	0.207	6635	5112	3.576	4644	1990
Rule A	0.7	ticker	0.2	no	no	68303	58556	0.015	0.108	0.150	0.140	0.033	0.238	0.329	11799	9779	2.883	8259	3540
Rule A	0.7	ticker	0.3	no	no	60914	52097	0.033	0.204	0.329	0.298	0.051	0.318	0.507	15775	13021	2.821	11041	4732
Rule A	0.7	ticker	0.4	no	no	54622	54622	0.052	0.315	0.522	0.467	0.067	0.419	0.673	19036	16134	5.470	13323	5713
Rule A	0.7	ticker	0.5	no	no	49340	49340	0.091	0.475	0.905	0.756	0.101	0.560	1.009	21239	21888	3.503	14849	6381
Rule A	0.7	ticker	0.6	no	no	45039	43161	0.134	0.619	1.338	1.084	0.140	0.684	1.398	23502	25872	3.458	16383	7119
Rule A	0.7	ticker	0.7	no	no	39996	38859	0.195	0.783	1.950	1.493	0.194	0.783	1.938	24485	28872	10.675	17027	7458
Rule A	0.7	ticker	0.8	no	no	37190	35857	0.234	0.831	2.336	1.726	0.231	0.867	2.313	24471	29475	49.606	16957	7514
Rule A	0.7	ticker	0.9	no	no	34035	30834	0.267	0.867	2.667	2.030	0.272	0.890	2.717	25126	31437	5.456	17287	7841
Rule A	0.7	ticker	1	no	no	29747	30022	0.347	0.943	3.465	2.418	0.327	0.950	3.274	24485	32802	4.646	16707	7778
Rule A	0.7	ticker	0.1	33000	no	76057	76168	0.010	0.074	0.101	0.098	0.025	0.173	0.253	6491	4837	1.882	4544	1947
Rule A	0.7	ticker	0.2	33000	no	68670	70697	0.017	0.116	0.172	0.161	0.032	0.230	0.324	11157	7970	2.172	7810	3347
Rule A	0.7	ticker	0.3	33000	no	62591	62467	0.025	0.171	0.254	0.239	0.043	0.289	0.428	14271	9882	2.662	9990	4281
Rule A	0.7	ticker	0.4	33000	no	56140	58573	0.046	0.294	0.479	0.432	0.065	0.409	0.645	16107	10515	2.942	11275	4832
Rule A	0.7	ticker	0.5	33000	no	56334	57310	0.062	0.382	0.616	0.560	0.075	0.455	0.748	17901	11031	2.471	12530	5370
Rule A	0.7	ticker	0.6	33000	no	52477	53338	0.086	0.435	0.862	0.721	0.097	0.508	0.969	18436	11410	3.961	12905	5531
Rule A	0.7	ticker	0.7	33000	no	51576	52044	0.097	0.488	0.974	0.802	0.106	0.569	1.062	19327	11722	2.316	13528	5798
Rule A	0.7	ticker	0.8	33000	no	49560	47488	0.116	0.553	1.162	0.893	0.123	0.591	1.234	19920	11855	3.104	13943	5976
Rule A	0.7	ticker	0.9	33000	no	46820	47852	0.129	0.576	1.292	1.010	0.135	0.622	1.354	20233	11883	2.043	14161	6072
Rule A	0.7	ticker	1	33000	no	46528	44838	0.155	0.685	1.547	1.204	0.156	0.708	1.563	20254	12288	3.756	14175	6079
Rule A	0.7	ticker	0.1	no	7000	78478	80581	0.009	0.061	0.086	0.080	0.024	1.000	6.337	4541	6173	NA	3179	1362
Rule A	0.7	ticker	0.2	no	7000	70218	73848	0.007	0.049	0.074	0.070	0.370	0.971	3.704	11026	11189	NA	7718	3308
Rule A	0.7	ticker	0.3	no	7000	62621	63864	0.016	0.127	0.183	0.169	0.307	0.947	3.068	15466	15342	NA	10841	4646
Rule A	0.7	ticker	0.4	no	7000	55208	56084	0.045	0.285	0.446	0.405	0.291	0.925	2.912	18471	19228	NA	12927	5544
Rule A	0.7	ticker	0.5	no	7000	50024	50819	0.084	0.431	0.840	0.706	0.303	0.933	3.028	20869	23080	1.074	14604	6265
Rule A	0.7	ticker	0.6	no	7000	45393	43809	0.125	0.581	1.251	1.023	0.319	0.954	3.184	22588	26009	NA	15784	6824
Rule A	0.7	ticker	0.7	no	7000	41310	41970	0.175	0.720	1.753	1.395	0.342	0.960	3.415	23316	28234	1.179	16218	7098
Rule A	0.7	ticker	0.8	no	7000	37678	38045	0.225	0.824	2.251	1.720	0.364	0.970	3.642	24861	30530	1.190	17209	7652
Rule A	0.7	ticker	0.9	no	7000	33787	31838	0.279	0.884	2.790	2.013	0.401	0.982	4.014	24623	31824	NA	16933	7690
Rule A	0.7	ticker	1	no	7000	30979	29847	0.331	0.922	3.309	2.276	0.433	0.987	4.334	24606	33460	1.279	16943	7665
Rule A	0.7	ticker	0.1	33000	7000	76525	82572	0.007	0.045	0.071	0.070	0.631	1.000	6.313	4561	6097	NA	3193	1368
Rule A	0.7	ticker	0.2	33000	7000	71068	74321	0.009	0.055	0.068	0.064	0.362	0.967	3.619	10264	9441	NA	7185	3079
Rule A	0.7	ticker	0.3	33000	7000	65018	66055	0.016	0.112	0.159	0.148	0.291	0.919	2.911	13797	10773	NA	9658	4139
Rule A	0.7	ticker	0.4	33000	7000	59526	61920	0.034	0.214	0.342	0.297	0.262	0.896	2.624	15701	11472	0.639	10991	4710
Rule A	0.7	ticker	0.5	33000	7000	57216	57283	0.052	0.307	0.516	0.465	0.245	0.867	2.448	17393	11870	NA	12175	5218
Rule A	0.7	ticker	0.6	33000	7000	54493	53729	0.066	0.356	0.660	0.565	0.239	0.896	2.392	18331	12162	0.581	12832	5500
Rule A	0.7	ticker	0.7	33000	7000	51916	51794	0.087	0.461	0.873	0.728	0.241	0.881	2.408	19081	12273	0.564	13356	5725
Rule A	0.7	ticker	0.8	33000	7000	50379	51570	0.112	0.533	1.120	0.898	0.243	0.883	2.432	19507	12358	0.544	13654	5853
Rule A	0.7	ticker	0.9	33000	7000	49121	49422	0.129	0.580	1.289	1.004	0.244	0.856	2.442	20056	12509	NA	14039	6020
Rule A	0.7	ticker	1	33000	7000	47476	48459	0.137	0.602	1.368	1.069	0.250	0.870	2.503	20133	12519	0.516	14090	6043

HCR	Allocat. % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB	Median SSB_{sim}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years $SSB<B_{lim}$	Nb years to $SSB>B_{lim}$	P(closure)	P(closure) once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule A	0.6	ricker	0.1	no	no	70407	70373	0.009	0.083	0.004	0.000	0.004	0.174	0.238	6595	5071	9.546	3957	2638
Rule A	0.6	ricker	0.2	no	no	67662	70288	0.013	0.086	0.130	0.125	0.032	0.225	0.315	11901	9846	2.426	7141	4761
Rule A	0.6	ricker	0.3	no	no	62180	65286	0.025	0.160	0.245	0.222	0.044	0.288	0.444	16062	14079	2.140	9649	6433
Rule A	0.6	ricker	0.4	no	no	54133	54288	0.058	0.323	0.584	0.508	0.076	0.440	0.782	18026	16448	3.166	11353	7571
Rule A	0.6	ricker	0.5	no	no	46977	48788	0.090	0.472	0.900	0.779	0.103	0.565	1.032	21610	22481	3.922	12955	8636
Rule A	0.6	ricker	0.6	no	no	45019	42719	0.129	0.603	1.283	1.077	0.132	0.648	1.320	23542	25880	5.073	14079	9483
Rule A	0.6	ricker	0.7	no	no	40518	41231	0.191	0.739	1.912	1.488	0.183	0.794	1.827	24271	28410	6.929	14446	9625
Rule A	0.6	ricker	0.8	no	no	36626	34802	0.235	0.828	2.346	1.725	0.226	0.837	2.258	24362	29378	8.789	14625	9837
Rule A	0.6	ricker	0.9	no	no	32699	31110	0.291	0.885	2.912	2.141	0.275	0.894	2.752	24681	31028	11.731	14694	10186
Rule A	0.6	ricker	1	no	no	30378	28918	0.344	0.931	3.437	2.336	0.324	0.933	3.241	24421	32374	14.036	14225	10157
Rule A	0.6	ricker	0.1	33000	no	76419	76888	0.006	0.060	0.062	0.079	0.023	0.171	0.228	6574	4888	1.991	3945	2630
Rule A	0.6	ricker	0.2	33000	no	66519	72429	0.014	0.095	0.138	0.132	0.029	0.223	0.280	11247	8020	3.111	6748	4499
Rule A	0.6	ricker	0.3	33000	no	64736	65601	0.022	0.147	0.224	0.206	0.035	0.246	0.351	14729	9832	4.469	8837	5891
Rule A	0.6	ricker	0.4	33000	no	59167	60926	0.041	0.284	0.407	0.378	0.057	0.373	0.573	16033	10451	2.324	9800	6533
Rule A	0.6	ricker	0.5	33000	no	55651	58031	0.057	0.342	0.587	0.492	0.073	0.452	0.725	17685	11078	17.263	10611	7074
Rule A	0.6	ricker	0.6	33000	no	54124	55525	0.076	0.416	0.758	0.630	0.092	0.520	0.921	18622	11388	2.184	11293	7529
Rule A	0.6	ricker	0.7	33000	no	51395	48881	0.094	0.504	0.939	0.743	0.107	0.582	1.070	19468	11531	6.264	11680	7787
Rule A	0.6	ricker	0.8	33000	no	50525	51417	0.111	0.548	1.113	0.895	0.122	0.624	1.224	19660	11821	1.937	11894	7996
Rule A	0.6	ricker	0.9	33000	no	47591	48395	0.136	0.578	1.376	1.063	0.143	0.644	1.425	20178	11882	2.020	12104	8074
Rule A	0.6	ricker	1	33000	no	46777	48394	0.149	0.642	1.488	1.142	0.160	0.712	1.603	20211	12145	2.899	12124	8086
Rule A	0.6	ricker	0.1	no	7000	79737	82330	0.006	0.045	0.063	0.059	0.029	0.098	0.288	4620	6375	NA	2814	1876
Rule A	0.6	ricker	0.2	no	7000	71031	73883	0.007	0.055	0.074	0.072	0.372	0.971	3.724	11049	11083	NA	6629	4420
Rule A	0.6	ricker	0.3	no	7000	62717	64487	0.015	0.114	0.148	0.138	0.303	0.928	3.028	15461	15310	NA	9265	6177
Rule A	0.6	ricker	0.4	no	7000	56043	58543	0.044	0.278	0.443	0.416	0.295	0.939	2.951	18549	19341	0.968	11128	7421
Rule A	0.6	ricker	0.5	no	7000	50930	50888	0.072	0.395	0.722	0.621	0.289	0.931	2.888	21755	23857	1.091	13031	8724
Rule A	0.6	ricker	0.6	no	7000	45986	45584	0.123	0.573	1.225	1.032	0.315	0.953	3.154	23129	26855	1.166	13831	9298
Rule A	0.6	ricker	0.7	no	7000	41335	40478	0.167	0.708	1.671	1.391	0.346	0.964	3.462	24065	28858	NA	14301	9763
Rule A	0.6	ricker	0.8	no	7000	36954	38333	0.230	0.818	2.301	1.731	0.377	0.981	3.773	24500	30822	1.262	14510	9668
Rule A	0.6	ricker	0.9	no	7000	33134	31583	0.294	0.887	2.936	2.125	0.412	0.993	4.123	24126	31880	1.296	14141	9665
Rule A	0.6	ricker	1	no	7000	30091	28559	0.342	0.923	3.417	2.355	0.437	0.995	4.372	24665	33519	1.279	14431	10453
Rule A	0.6	ricker	0.1	33000	7000	76865	83124	0.007	0.057	0.074	0.071	0.026	0.096	0.264	4700	6230	NA	2820	1880
Rule A	0.6	ricker	0.2	33000	7000	70205	73027	0.011	0.072	0.112	0.101	0.350	0.970	3.799	10105	9255	NA	6065	4043
Rule A	0.6	ricker	0.3	33000	7000	64107	64858	0.020	0.141	0.204	0.190	0.294	0.923	2.942	13631	10708	NA	8179	5453
Rule A	0.6	ricker	0.4	33000	7000	60369	60054	0.029	0.168	0.287	0.260	0.257	0.890	2.567	16035	11445	0.836	9621	6414
Rule A	0.6	ricker	0.5	33000	7000	57224	57843	0.046	0.302	0.466	0.419	0.248	0.881	2.485	17474	11830	0.599	10484	6990
Rule A	0.6	ricker	0.6	33000	7000	54691	57679	0.074	0.384	0.739	0.646	0.242	0.885	2.419	18409	12071	NA	11045	7363
Rule A	0.6	ricker	0.7	33000	7000	52059	54133	0.086	0.483	0.862	0.720	0.241	0.870	2.411	19017	12302	0.564	11410	7607
Rule A	0.6	ricker	0.8	33000	7000	49362	49110	0.113	0.528	1.127	0.874	0.256	0.868	2.564	19206	12550	0.549	11524	7684
Rule A	0.6	ricker	0.9	33000	7000	46513	46850	0.123	0.588	1.231	0.971	0.250	0.873	2.488	19791	12707	0.537	11873	7918
Rule A	0.6	ricker	1	33000	7000	47332	46129	0.142	0.657	1.422	1.109	0.252	0.857	2.520	20142	12849	0.518	12083	8056

HCR	Allocat % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB	Median SSB_{sim}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years SSB<B_{lim}	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule A	0.5	ricker	0.1	no	no	76202	80840	0.010	0.073	0.103	0.095	0.026	0.178	0.258	6559	5393	2.850	3280	3280
Rule A	0.5	ricker	0.2	no	no	68130	72854	0.016	0.107	0.163	0.146	0.037	0.264	0.388	12013	9897	2.466	6007	6007
Rule A	0.5	ricker	0.3	no	no	61526	62287	0.026	0.175	0.277	0.255	0.045	0.305	0.450	16070	14193	2.911	8035	8035
Rule A	0.5	ricker	0.4	no	no	55913	58014	0.046	0.280	0.459	0.398	0.067	0.402	0.585	19624	18587	4.431	9812	9812
Rule A	0.5	ricker	0.5	no	no	49423	48710	0.084	0.448	0.841	0.705	0.095	0.529	0.947	21546	22205	3.442	10780	10766
Rule A	0.5	ricker	0.6	no	no	45276	46204	0.131	0.627	1.307	1.069	0.137	0.662	1.385	23266	25216	3.036	11601	11665
Rule A	0.5	ricker	0.7	no	no	40457	38042	0.179	0.711	1.789	1.386	0.179	0.747	1.789	24366	28593	4.626	12030	12278
Rule A	0.5	ricker	0.8	no	no	36653	36082	0.229	0.809	2.291	1.661	0.227	0.842	2.286	24667	30210	4.664	12129	12559
Rule A	0.5	ricker	0.9	no	no	32826	30457	0.293	0.885	2.925	2.120	0.277	0.901	2.772	24996	32074	4.680	12141	12855
Rule A	0.5	ricker	1	no	no	29978	28027	0.344	0.930	3.436	2.423	0.326	0.938	3.259	25150	33880	7.340	12095	13054
Rule A	0.5	ricker	0.1	33000	no	76406	81019	0.010	0.080	0.095	0.086	0.022	0.157	0.219	6580	4836	2.253	3290	3290
Rule A	0.5	ricker	0.2	33000	no	69030	73904	0.016	0.111	0.177	0.155	0.035	0.235	0.345	11156	7956	2.343	5579	5579
Rule A	0.5	ricker	0.3	33000	no	64152	66820	0.025	0.168	0.248	0.234	0.042	0.285	0.415	14433	9833	2.628	7217	7217
Rule A	0.5	ricker	0.4	33000	no	59141	60104	0.044	0.266	0.436	0.388	0.056	0.370	0.581	16425	10831	2.635	8212	8212
Rule A	0.5	ricker	0.5	33000	no	55541	55296	0.061	0.341	0.610	0.541	0.082	0.469	0.816	17611	11082	2.294	8806	8806
Rule A	0.5	ricker	0.6	33000	no	52472	52297	0.074	0.419	0.737	0.619	0.089	0.499	0.889	18549	11455	2.359	9274	9275
Rule A	0.5	ricker	0.7	33000	no	51250	53556	0.097	0.480	0.969	0.805	0.110	0.568	1.089	19149	11823	1.954	9574	9575
Rule A	0.5	ricker	0.8	33000	no	49570	46805	0.117	0.560	1.166	0.907	0.123	0.598	1.229	19544	11757	NA	9921	9923
Rule A	0.5	ricker	0.9	33000	no	48050	48979	0.129	0.603	1.291	1.006	0.136	0.662	1.382	20066	12103	2.347	10046	10050
Rule A	0.5	ricker	1	33000	no	47302	47409	0.143	0.624	1.434	1.101	0.151	0.686	1.507	20417	12174	2.685	10206	10210
Rule A	0.5	ricker	0.1	no	7000	76375	83858	0.010	0.083	0.099	0.092	0.839	1.000	6.387	4517	6217	NA	2259	2259
Rule A	0.5	ricker	0.2	no	7000	69282	70881	0.011	0.089	0.108	0.104	0.389	0.979	3.892	10579	10893	NA	5289	5289
Rule A	0.5	ricker	0.3	no	7000	63052	62372	0.015	0.105	0.154	0.145	0.301	0.933	3.008	15699	15395	NA	7805	7805
Rule A	0.5	ricker	0.4	no	7000	55955	55877	0.036	0.258	0.379	0.348	0.290	0.928	2.898	18361	18758	0.935	9179	9181
Rule A	0.5	ricker	0.5	no	7000	50657	48554	0.073	0.386	0.734	0.634	0.295	0.925	2.948	20951	22858	1.026	10463	10467
Rule A	0.5	ricker	0.6	no	7000	45581	43549	0.116	0.569	1.164	0.958	0.305	0.953	3.054	22729	25175	1.112	11323	11406
Rule A	0.5	ricker	0.7	no	7000	41969	41668	0.168	0.690	1.682	1.342	0.335	0.960	3.348	24277	28838	1.207	12029	12248
Rule A	0.5	ricker	0.8	no	7000	37191	34884	0.223	0.805	2.230	1.704	0.370	0.982	3.697	25170	31383	1.256	12364	12806
Rule A	0.5	ricker	0.9	no	7000	33573	30811	0.269	0.870	2.604	2.047	0.399	0.991	3.988	25202	33040	1.300	12249	12953
Rule A	0.5	ricker	1	no	7000	31040	28514	0.333	0.928	3.326	2.398	0.430	0.992	4.300	25555	34444	1.303	12270	13285
Rule A	0.5	ricker	0.1	33000	7000	79030	83231	0.008	0.059	0.082	0.081	0.831	1.000	6.308	4559	6180	NA	2279	2279
Rule A	0.5	ricker	0.2	33000	7000	70340	76443	0.010	0.085	0.096	0.092	0.383	0.971	3.828	10053	9279	NA	5026	5026
Rule A	0.5	ricker	0.3	33000	7000	64355	67122	0.016	0.126	0.175	0.162	0.296	0.924	2.976	13594	10880	NA	6797	6797
Rule A	0.5	ricker	0.4	33000	7000	60921	59058	0.033	0.209	0.331	0.305	0.259	0.892	2.591	15955	11483	0.839	7977	7977
Rule A	0.5	ricker	0.5	33000	7000	57964	57080	0.044	0.278	0.438	0.401	0.238	0.859	2.382	17676	11884	0.569	8838	8838
Rule A	0.5	ricker	0.6	33000	7000	54201	54380	0.070	0.389	0.696	0.591	0.245	0.881	2.448	18248	12102	0.594	9124	9124
Rule A	0.5	ricker	0.7	33000	7000	53091	53856	0.084	0.448	0.841	0.705	0.232	0.881	2.324	19370	12340	0.556	9685	9685
Rule A	0.5	ricker	0.8	33000	7000	51676	50772	0.099	0.503	0.966	0.812	0.230	0.841	2.303	19869	12297	0.537	9934	9965
Rule A	0.5	ricker	0.9	33000	7000	48820	49105	0.121	0.558	1.212	0.963	0.247	0.880	2.466	19917	12529	0.531	9957	9960
Rule A	0.5	ricker	1	33000	7000	48135	47303	0.136	0.612	1.359	1.069	0.243	0.883	2.433	20524	12497	0.507	10260	10264

HCR	Allocat. % Spain	SR	HR	TAC_{ini}	TAC_{int}	Median SSB	Median SSB_{int}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years $SSB<B_{lim}$	Nb years to SSB<Blim	P(closure)	P(closure) once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule B	cte	ctoker	0.1	no	no	72178	74742	0.017	0.159	0.166	0.165	0.033	0.217	0.328	6145	5132	2.140	4073	4073
Rule B	cte	ctoker	0.2	no	no	63793	66586	0.033	0.155	0.326	0.300	0.047	0.297	0.472	14791	10115	2.320	7395	7395
Rule B	cte	ctoker	0.3	no	no	54100	52052	0.066	0.373	0.677	0.575	0.081	0.461	0.614	19423	14778	4.591	9711	9712
Rule B	cte	ctoker	0.4	no	no	46822	40756	0.124	0.556	1.237	0.991	0.134	0.666	1.335	22651	18557	3.232	11338	11342
Rule B	cte	ctoker	0.5	no	no	39995	30970	0.206	0.774	2.056	1.528	0.205	0.820	2.051	24106	22717	2.496	12045	12061
Rule B	cte	ctoker	0.6	no	no	34655	32381	0.263	0.854	2.633	1.837	0.255	0.880	2.548	25716	26215	15.141	12805	12913
Rule B	cte	ctoker	0.7	no	no	29040	28132	0.353	0.852	3.526	2.374	0.331	0.948	3.313	25600	28724	3.232	12680	12920
Rule B	cte	ctoker	0.8	no	no	24455	22891	0.438	0.877	4.378	2.741	0.403	0.988	4.034	25024	31384	3.771	12265	12759
Rule B	cte	ctoker	0.9	no	no	21326	20482	0.493	0.891	4.933	3.076	0.451	0.993	4.512	24775	32497	5.182	12038	12737
Rule B	cte	ctoker	1	no	no	18490	18897	0.544	0.886	5.435	3.352	0.497	0.997	4.971	23656	33112	12.276	11443	12407
Rule B	cte	ctoker	0.1	325000	no	74537	78834	0.015	0.090	0.128	0.121	0.026	0.192	0.264	6239	5047	1.875	4169	4169
Rule B	cte	ctoker	0.2	325000	no	65719	64231	0.033	0.191	0.327	0.288	0.048	0.360	0.475	13861	7885	2.727	6981	6981
Rule B	cte	ctoker	0.3	325000	no	56164	56043	0.063	0.360	0.629	0.555	0.078	0.462	0.782	17218	9503	2.808	8609	8609
Rule B	cte	ctoker	0.4	325000	no	50755	48525	0.107	0.516	1.072	0.862	0.117	0.564	1.167	19164	10574	2.434	9582	9582
Rule B	cte	ctoker	0.5	325000	no	46160	47530	0.145	0.607	1.446	1.114	0.156	0.677	1.555	20084	11309	2.391	10191	10193
Rule B	cte	ctoker	0.6	325000	no	45976	43325	0.172	0.688	1.717	1.257	0.172	0.709	1.722	21403	11745	12.259	10708	10715
Rule B	cte	ctoker	0.7	325000	no	44191	40897	0.204	0.738	2.038	1.431	0.194	0.748	1.940	21629	12220	1.843	10807	10822
Rule B	cte	ctoker	0.8	325000	no	40097	37040	0.236	0.769	2.357	1.659	0.228	0.797	2.282	21352	12885	2.348	10662	10690
Rule B	cte	ctoker	0.9	325000	no	40458	35843	0.242	0.776	2.416	1.700	0.234	0.807	2.342	21582	12782	2.229	10778	10804
Rule B	cte	ctoker	1	325000	no	38857	35248	0.268	0.800	2.682	1.828	0.262	0.822	2.623	21345	12973	4.115	10654	10691
Rule B	cte	ctoker	0.1	no	7000	76695	78209	0.008	0.054	0.076	0.076	0.479	0.994	4.789	6551	6911	NA	3276	3276
Rule B	cte	ctoker	0.2	no	7000	63798	65488	0.023	0.155	0.228	0.219	0.188	0.779	1.881	14219	10553	0.660	7109	7109
Rule B	cte	ctoker	0.3	no	7000	53821	54622	0.061	0.343	0.607	0.520	0.196	0.790	1.957	19004	15429	0.728	9502	9502
Rule B	cte	ctoker	0.4	no	7000	46259	45459	0.108	0.551	1.083	0.890	0.227	0.854	2.268	22947	18882	0.796	11469	11478
Rule B	cte	ctoker	0.5	no	7000	39967	37439	0.202	0.781	2.019	1.467	0.300	0.940	3.002	24029	23085	0.843	11998	12031
Rule B	cte	ctoker	0.6	no	7000	34449	32910	0.276	0.891	2.756	1.953	0.350	0.981	3.498	25203	26822	0.928	12587	12597
Rule B	cte	ctoker	0.7	no	7000	29691	27844	0.356	0.946	3.559	2.320	0.411	0.994	4.105	25790	29732	0.982	12734	13056
Rule B	cte	ctoker	0.8	no	7000	25448	24286	0.420	0.973	4.201	2.704	0.466	0.995	4.654	24771	31354	1.039	12132	12640
Rule B	cte	ctoker	0.9	no	7000	21393	19245	0.493	0.989	4.933	3.071	0.512	0.998	5.118	24628	32537	1.062	11945	12683
Rule B	cte	ctoker	1	no	7000	19055	20094	0.533	0.990	5.330	3.352	0.548	0.998	5.481	24151	33830	1.068	11573	12579
Rule B	cte	ctoker	0.1	325000	7000	76498	83780	0.007	0.048	0.073	0.068	0.479	0.992	4.789	6499	6881	NA	3249	3249
Rule B	cte	ctoker	0.2	325000	7000	64909	68040	0.022	0.145	0.221	0.205	0.187	0.762	1.870	13824	8828	0.588	6762	6762
Rule B	cte	ctoker	0.3	325000	7000	57146	57628	0.060	0.334	0.601	0.496	0.182	0.750	1.823	17266	10121	0.527	8634	8634
Rule B	cte	ctoker	0.4	325000	7000	52005	52033	0.093	0.488	0.927	0.766	0.211	0.825	2.112	19191	11224	0.493	9595	9595
Rule B	cte	ctoker	0.5	325000	7000	49042	44883	0.138	0.624	1.377	1.054	0.241	0.857	2.409	19877	11881	NA	9937	9939
Rule B	cte	ctoker	0.6	325000	7000	45723	40147	0.161	0.690	1.609	1.316	0.264	0.857	2.637	20596	12284	0.447	10295	10301
Rule B	cte	ctoker	0.7	325000	7000	42428	41276	0.203	0.743	2.029	1.484	0.274	0.881	2.744	21069	12789	0.436	10529	10540
Rule B	cte	ctoker	0.8	325000	7000	40060	38213	0.244	0.792	2.436	1.744	0.297	0.877	2.972	20935	12823	0.436	10454	10481
Rule B	cte	ctoker	0.9	325000	7000	40412	34291	0.244	0.775	2.436	1.726	0.288	0.872	2.881	21515	12908	0.421	10741	10774
Rule B	cte	ctoker	1	325000	7000	37960	35121	0.267	0.803	2.666	1.853	0.306	0.887	3.062	21164	13291	0.418	10561	10603

HCR	Allocat. % Spain	SR	HR	TAC_{ini}	TAC_{ann}	Median SSB	Median SSB_{ini}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years $SSB<B_{lim}$	Nb years to SSB>Blim	P(closure)	P(closure) once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule 0	var	ricker	0.1	no	no	74391	80795	0.013	0.088	0.128	0.117	0.028	0.203	0.277	8225	5158	1.282	6570	1753
Rule 0	var	ricker	0.2	no	no	65830	67473	0.031	0.192	0.307	0.272	0.048	0.307	0.479	14673	9859	2.358	10605	4068
Rule 0	var	ricker	0.3	no	no	59067	52854	0.073	0.400	0.728	0.609	0.088	0.496	0.852	18664	14627	2.998	13079	5605
Rule 0	var	ricker	0.4	no	no	46721	43858	0.132	0.597	1.324	1.044	0.132	0.628	1.322	22793	19520	3.722	15219	7574
Rule 0	var	ricker	0.5	no	no	36869	37299	0.213	0.795	2.133	1.557	0.207	0.821	2.088	24101	23517	4.726	15837	8264
Rule 0	var	ricker	0.6	no	no	33734	31299	0.283	0.878	2.829	1.970	0.270	0.897	2.695	25037	26121	3.679	16182	8855
Rule 0	var	ricker	0.7	no	no	28805	28784	0.369	0.955	3.686	2.490	0.338	0.956	3.380	25464	28353	4.279	16226	9226
Rule 0	var	ricker	0.8	no	no	24367	23812	0.436	0.977	4.364	2.781	0.404	0.975	4.042	24821	30017	5.068	15931	9220
Rule 0	var	ricker	0.9	no	no	21264	20868	0.497	0.991	4.965	3.166	0.460	0.995	4.597	23967	33088	4.587	14901	9067
Rule 0	var	ricker	1	no	no	18268	17538	0.549	0.994	5.485	3.402	0.502	0.997	5.019	23261	32749	7.287	14358	8923
Rule 0	var	ricker	0.1	35000	no	75275	77979	0.015	0.089	0.152	0.140	0.030	0.200	0.304	6206	4024	1.810	6492	1713
Rule 0	var	ricker	0.2	35000	no	65460	65488	0.030	0.188	0.295	0.264	0.047	0.308	0.468	13790	7971	4.117	10054	3737
Rule 0	var	ricker	0.3	35000	no	56995	55804	0.062	0.352	0.621	0.536	0.077	0.458	0.774	17375	9545	1.896	12045	5330
Rule 0	var	ricker	0.4	35000	no	51252	51343	0.106	0.527	1.058	0.850	0.118	0.569	1.175	19159	10588	2.612	12912	6247
Rule 0	var	ricker	0.5	35000	no	46214	46516	0.151	0.637	1.506	1.138	0.151	0.672	1.510	20660	11188	1.743	13283	6808
Rule 0	var	ricker	0.6	35000	no	43097	41677	0.201	0.728	2.008	1.474	0.156	0.775	1.562	20435	12075	2.622	13312	7123
Rule 0	var	ricker	0.7	35000	no	42038	41694	0.213	0.741	2.132	1.563	0.206	0.774	2.062	21257	12458	4.246	13702	7555
Rule 0	var	ricker	0.8	35000	no	41377	39072	0.259	0.781	2.587	1.700	0.225	0.804	2.247	21362	12772	2.515	13692	7670
Rule 0	var	ricker	0.9	35000	no	40416	38470	0.252	0.784	2.524	1.786	0.240	0.815	2.395	21504	12787	4.892	13723	7781
Rule 0	var	ricker	1	35000	no	37146	35311	0.275	0.809	2.747	1.931	0.263	0.818	2.628	20679	13073	2.039	13339	7340
Rule 0	var	ricker	0.1	no	7000	75773	78151	0.010	0.081	0.097	0.094	0.475	0.980	4.749	6461	6828	NA	4970	1492
Rule 0	var	ricker	0.2	no	7000	62422	65460	0.027	0.171	0.265	0.239	0.194	0.795	1.938	14043	10589	0.684	10096	3947
Rule 0	var	ricker	0.3	no	7000	55031	58149	0.063	0.347	0.633	0.532	0.156	0.617	1.563	19163	15483	0.730	13112	6051
Rule 0	var	ricker	0.4	no	7000	47154	45595	0.123	0.579	1.225	1.013	0.237	0.867	2.369	22266	19300	0.788	14832	7434
Rule 0	var	ricker	0.5	no	7000	39667	38245	0.196	0.759	1.960	1.483	0.300	0.939	3.003	24123	23484	0.838	15757	8366
Rule 0	var	ricker	0.6	no	7000	34573	31948	0.274	0.881	2.735	1.921	0.357	0.959	3.574	25094	26488	NA	16145	8948
Rule 0	var	ricker	0.7	no	7000	29527	27825	0.355	0.940	3.551	2.392	0.412	0.983	4.124	25466	29228	0.868	16172	9226
Rule 0	var	ricker	0.8	no	7000	24805	23152	0.432	0.973	4.316	2.759	0.470	0.996	4.697	24562	30891	1.032	15381	9171
Rule 0	var	ricker	0.9	no	7000	22748	21831	0.467	0.985	4.668	2.923	0.494	0.998	4.943	24916	32514	1.092	15490	9427
Rule 0	var	ricker	1	no	7000	19404	17917	0.530	0.994	5.295	3.304	0.545	0.998	5.452	24340	33838	1.050	14949	9392
Rule 0	var	ricker	0.1	35000	7000	75629	79108	0.007	0.050	0.069	0.067	0.478	0.991	4.757	6412	6584	NA	4932	1479
Rule 0	var	ricker	0.2	35000	7000	64316	65185	0.021	0.135	0.207	0.186	0.186	0.778	1.860	13905	9832	0.567	9758	3747
Rule 0	var	ricker	0.3	35000	7000	56618	58889	0.057	0.319	0.585	0.480	0.191	0.766	1.915	16965	10178	NA	11714	5271
Rule 0	var	ricker	0.4	35000	7000	51765	48852	0.096	0.508	0.978	0.819	0.207	0.822	2.068	19168	11032	0.496	12858	6330
Rule 0	var	ricker	0.5	35000	7000	47464	45524	0.136	0.628	1.358	1.086	0.232	0.841	2.318	20203	11778	0.485	13330	6953
Rule 0	var	ricker	0.6	35000	7000	44560	43724	0.161	0.708	1.609	1.335	0.268	0.867	2.680	20774	12275	0.464	13472	7302
Rule 0	var	ricker	0.7	35000	7000	43161	42810	0.207	0.741	2.065	1.471	0.272	0.874	2.720	21241	12650	0.430	13636	7605
Rule 0	var	ricker	0.8	35000	7000	40254	38589	0.254	0.784	2.538	1.644	0.282	0.880	2.818	21061	13013	0.435	13464	7597
Rule 0	var	ricker	0.9	35000	7000	39367	38073	0.253	0.785	2.527	1.745	0.295	0.877	2.949	21228	13103	0.436	13525	7703
Rule 0	var	ricker	1	35000	7000	38439	35847	0.268	0.811	2.677	1.846	0.304	0.868	3.041	21143	13170	0.422	13464	7678

HCR	Allocat. % Spain	SR	HR	TAC_{min}	TAC_{max}	Median SSB	Median SSB_{last}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years $SSB<B_{lim}$	Nb years to $SSB>B_{lim}$	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule B	0.9	ticker	0.1	no	no	73737	78074	0.014	0.094	0.140	0.127	0.027	0.183	0.285	8454	9376	1.570	5904	2530
Rule B	0.9	ticker	0.2	no	no	62763	63862	0.033	0.199	0.327	0.295	0.043	0.291	0.434	14590	9721	2.057	10213	4377
Rule B	0.9	ticker	0.3	no	no	54422	55763	0.068	0.378	0.683	0.586	0.065	0.466	0.651	19522	10231	3.052	13668	5857
Rule B	0.9	ticker	0.4	no	no	48824	48174	0.131	0.608	1.311	1.057	0.139	0.676	1.388	22969	10595	4.815	16798	6772
Rule B	0.9	ticker	0.5	no	no	40039	39738	0.200	0.768	2.025	1.518	0.200	0.807	2.003	24035	22972	3.978	17021	7314
Rule B	0.9	ticker	0.6	no	no	33688	33049	0.290	0.889	2.902	2.075	0.276	0.912	2.759	24669	26183	4.894	17452	7547
Rule B	0.9	ticker	0.7	no	no	28971	28557	0.352	0.945	3.519	2.328	0.330	0.953	3.301	25015	28503	6.846	17370	7644
Rule B	0.9	ticker	0.8	no	no	24116	23945	0.443	0.978	4.432	2.853	0.406	0.978	4.055	24468	29835	9.678	16896	7572
Rule B	0.9	ticker	0.9	no	no	21760	19822	0.486	0.992	4.860	3.064	0.446	0.991	4.459	24624	31900	9.691	16866	7758
Rule B	0.9	ticker	1	no	no	18811	18217	0.541	0.993	5.406	3.316	0.497	0.996	4.967	23547	32484	5.358	16385	7583
Rule B	0.9	ticker	0.1	320000	no	74225	77420	0.010	0.088	0.100	0.092	0.025	0.174	0.248	8230	4973	1.462	5831	2499
Rule B	0.9	ticker	0.2	320000	no	62952	65242	0.033	0.186	0.329	0.294	0.047	0.292	0.473	14043	7886	2.322	9833	4213
Rule B	0.9	ticker	0.3	320000	no	56616	56812	0.063	0.357	0.627	0.522	0.078	0.468	0.775	17405	9724	1.767	12183	5221
Rule B	0.9	ticker	0.4	320000	no	50773	48956	0.108	0.529	1.083	0.888	0.121	0.633	1.211	19155	10759	1.966	13409	5747
Rule B	0.9	ticker	0.5	320000	no	47610	44530	0.144	0.632	1.442	1.106	0.144	0.677	1.439	20549	11334	3.296	14383	6166
Rule B	0.9	ticker	0.6	320000	no	44693	43915	0.180	0.699	1.796	1.337	0.182	0.722	1.820	20652	11897	2.095	14663	6289
Rule B	0.9	ticker	0.7	320000	no	42617	39855	0.214	0.742	2.137	1.499	0.209	0.778	2.089	21273	12352	1.878	14881	6391
Rule B	0.9	ticker	0.8	320000	no	41467	39020	0.233	0.779	2.333	1.710	0.223	0.798	2.227	21440	12682	3.065	14995	6446
Rule B	0.9	ticker	0.9	320000	no	39767	38753	0.255	0.786	2.548	1.787	0.242	0.809	2.424	21429	12789	2.674	14974	6447
Rule B	0.9	ticker	1	320000	no	37606	35771	0.284	0.811	2.838	1.989	0.268	0.823	2.682	20937	12887	1.510	14560	6277
Rule B	0.9	ticker	0.1	no	7000	75582	78329	0.006	0.054	0.079	0.076	0.462	0.992	4.621	6446	6817	NA	4516	1935
Rule B	0.9	ticker	0.2	no	7000	64273	64343	0.024	0.164	0.239	0.218	0.187	0.768	1.868	14460	10853	NA	10122	4338
Rule B	0.9	ticker	0.3	no	7000	53339	54717	0.066	0.384	0.662	0.582	0.210	0.821	2.100	18701	15158	0.732	13091	5610
Rule B	0.9	ticker	0.4	no	7000	46938	44285	0.125	0.574	1.251	0.996	0.253	0.880	2.528	21833	19255	0.793	15283	6550
Rule B	0.9	ticker	0.5	no	7000	40470	38145	0.199	0.762	1.987	1.492	0.301	0.941	3.005	24276	23358	0.878	16973	7302
Rule B	0.9	ticker	0.6	no	7000	34205	33504	0.273	0.889	2.728	1.943	0.357	0.971	3.569	24834	26097	0.917	17333	7501
Rule B	0.9	ticker	0.7	no	7000	29957	29165	0.350	0.942	3.496	2.284	0.411	0.981	4.108	25104	28857	0.981	17427	7578
Rule B	0.9	ticker	0.8	no	7000	25216	23108	0.422	0.975	4.218	2.643	0.469	0.993	4.697	24949	30469	1.026	17207	7742
Rule B	0.9	ticker	0.9	no	7000	22229	20225	0.476	0.987	4.776	2.937	0.503	0.997	5.032	25005	32818	1.022	17172	7913
Rule B	0.9	ticker	1	no	7000	19096	17855	0.528	0.998	5.284	3.169	0.532	1.000	5.318	24999	34475	NA	16889	8020
Rule B	0.9	ticker	0.1	320000	7000	76613	80701	0.005	0.039	0.053	0.051	0.469	0.994	4.693	6266	6885	NA	4530	1967
Rule B	0.9	ticker	0.2	320000	7000	63457	65338	0.021	0.148	0.211	0.188	0.185	0.800	1.854	13253	8589	0.569	9347	4006
Rule B	0.9	ticker	0.3	320000	7000	55762	57315	0.060	0.351	0.627	0.551	0.196	0.921	1.961	18066	10289	NA	11689	5009
Rule B	0.9	ticker	0.4	320000	7000	51695	54971	0.093	0.469	0.925	0.794	0.219	0.917	2.189	19630	11000	0.504	13321	5709
Rule B	0.9	ticker	0.5	320000	7000	48907	48520	0.141	0.602	1.411	1.101	0.237	0.927	2.367	20224	11714	0.468	14155	6069
Rule B	0.9	ticker	0.6	320000	7000	45221	42339	0.174	0.677	1.743	1.286	0.251	0.957	2.514	20037	12184	0.445	14651	6286
Rule B	0.9	ticker	0.7	320000	7000	42872	42563	0.207	0.732	2.074	1.481	0.275	0.981	2.751	21103	12555	0.435	14793	6340
Rule B	0.9	ticker	0.8	320000	7000	40516	39702	0.236	0.774	2.355	1.668	0.287	0.974	2.872	21240	12824	0.428	14852	6388
Rule B	0.9	ticker	0.9	320000	7000	39962	38079	0.247	0.773	2.472	1.692	0.299	0.971	2.985	21369	12948	0.429	14939	6430
Rule B	0.9	ticker	1	320000	7000	37689	35838	0.262	0.807	2.617	1.854	0.302	0.993	3.018	21132	13221	0.419	14769	6383

HCR	Allocat. % Spain	SR	HR	TAC_{sea}	TAC_{sen}	Median SSB	Median SSB_{sen}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years SSB<B_{lim}	Nb years to SSB>Blim	P(closure)	P(closure) once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule B	0.6	ticker	0.1	no	no	75740	77705	0.015	0.097	0.149	0.139	0.030	0.205	0.289	6242	5131	3.816	6594	1648
Rule B	0.6	ticker	0.2	no	no	62978	65004	0.030	0.101	0.296	0.285	0.045	0.296	0.453	14619	10300	2.952	11855	2964
Rule B	0.6	ticker	0.3	no	no	53700	54851	0.072	0.398	0.720	0.621	0.083	0.454	0.832	19042	15048	1.942	15473	3869
Rule B	0.6	ticker	0.4	no	no	45505	44412	0.137	0.821	1.371	1.089	0.142	0.687	1.421	22153	19184	NA	17719	4430
Rule B	0.6	ticker	0.5	no	no	39091	35185	0.213	0.789	2.133	1.591	0.209	0.809	2.090	24160	22587	2.785	19329	4831
Rule B	0.6	ticker	0.6	no	no	32685	31113	0.291	0.892	2.913	2.051	0.284	0.911	2.835	24222	25825	6.782	19326	4666
Rule B	0.6	ticker	0.7	no	no	28638	28838	0.366	0.859	3.663	2.472	0.342	0.964	3.419	25152	28778	3.002	19971	5161
Rule B	0.6	ticker	0.8	no	no	24518	22349	0.441	0.880	4.407	2.831	0.404	0.976	4.041	24479	30227	3.926	19381	5116
Rule B	0.6	ticker	0.9	no	no	21271	20330	0.494	0.886	4.944	3.133	0.453	0.986	4.532	23696	31178	9.069	18768	5069
Rule B	0.6	ticker	1	no	no	19093	17518	0.532	0.897	5.321	3.304	0.483	0.995	4.834	23663	32439	10.040	18938	5145
Rule B	0.6	ticker	0.1	35000	no	73330	76857	0.013	0.084	0.131	0.120	0.028	0.197	0.278	6247	4884	1.472	6597	1649
Rule B	0.6	ticker	0.2	35000	no	63137	65307	0.028	0.100	0.280	0.256	0.045	0.312	0.454	13766	7915	2.662	11013	2753
Rule B	0.6	ticker	0.3	35000	no	55502	55478	0.074	0.394	0.742	0.634	0.089	0.480	0.888	17094	9858	7.218	13675	3418
Rule B	0.6	ticker	0.4	35000	no	51305	52588	0.112	0.530	1.118	0.901	0.122	0.602	1.223	19173	10748	6.025	15338	3835
Rule B	0.6	ticker	0.5	35000	no	47109	49188	0.152	0.610	1.520	1.177	0.152	0.677	1.521	20034	11330	3.561	16266	4066
Rule B	0.6	ticker	0.6	35000	no	44466	43998	0.169	0.685	1.692	1.397	0.190	0.727	1.897	20629	11774	1.982	16659	4170
Rule B	0.6	ticker	0.7	35000	no	40606	41540	0.228	0.764	2.278	1.590	0.222	0.800	2.220	20601	12538	2.424	16472	4120
Rule B	0.6	ticker	0.8	35000	no	40216	40351	0.241	0.801	2.407	1.714	0.238	0.824	2.358	21071	12928	2.466	16843	4228
Rule B	0.6	ticker	0.9	35000	no	39051	35101	0.256	0.811	2.562	1.865	0.247	0.824	2.471	21264	12937	1.518	16975	4269
Rule B	0.6	ticker	1	35000	no	38061	34859	0.261	0.823	2.609	1.858	0.248	0.826	2.483	21464	13052	2.285	17141	4313
Rule B	0.6	ticker	0.1	no	7000	75618	77861	0.008	0.052	0.079	0.075	0.479	0.993	4.793	6483	6831	NA	5186	1297
Rule B	0.6	ticker	0.2	no	7000	64487	67033	0.027	0.158	0.265	0.229	0.189	0.771	1.894	14525	11157	NA	11620	2905
Rule B	0.6	ticker	0.3	no	7000	54268	51371	0.067	0.352	0.674	0.571	0.202	0.818	2.023	19084	15377	NA	15267	3817
Rule B	0.6	ticker	0.4	no	7000	46764	45312	0.127	0.591	1.274	1.022	0.246	0.881	2.462	22301	19511	0.792	17838	4460
Rule B	0.6	ticker	0.5	no	7000	40932	37804	0.203	0.784	2.027	1.539	0.297	0.938	2.969	24472	23850	0.856	19561	4891
Rule B	0.6	ticker	0.6	no	7000	33985	33809	0.290	0.888	2.896	2.101	0.363	0.967	3.630	25417	27885	0.935	20253	5164
Rule B	0.6	ticker	0.7	no	7000	29457	28559	0.371	0.882	3.706	2.528	0.423	0.986	4.231	24868	29300	0.969	19773	5095
Rule B	0.6	ticker	0.8	no	7000	25155	23380	0.428	0.878	4.283	2.739	0.485	0.994	4.849	24859	30204	0.883	19437	5121
Rule B	0.6	ticker	0.9	no	7000	22149	21467	0.476	0.887	4.761	3.019	0.503	0.997	5.033	25229	33283	1.053	19847	5383
Rule B	0.6	ticker	1	no	7000	19788	19337	0.541	0.892	5.407	3.392	0.549	0.997	5.488	23424	32971	1.040	18350	5074
Rule B	0.6	ticker	0.1	35000	7000	76482	80878	0.010	0.065	0.095	0.090	0.466	0.987	4.661	6570	6817	NA	5256	1314
Rule B	0.6	ticker	0.2	35000	7000	64604	66893	0.022	0.150	0.216	0.200	0.185	0.774	1.854	13663	8782	NA	10922	2731
Rule B	0.6	ticker	0.3	35000	7000	55554	55317	0.061	0.358	0.613	0.527	0.196	0.805	1.957	16810	10180	0.526	13448	3362
Rule B	0.6	ticker	0.4	35000	7000	51520	51958	0.101	0.477	1.009	0.806	0.215	0.819	2.153	18958	10808	0.493	15150	3788
Rule B	0.6	ticker	0.5	35000	7000	47364	48148	0.143	0.615	1.425	1.133	0.239	0.842	2.392	20009	11723	0.471	16005	4004
Rule B	0.6	ticker	0.6	35000	7000	44058	44010	0.167	0.709	1.670	1.381	0.264	0.852	2.642	20567	12407	0.444	16449	4116
Rule B	0.6	ticker	0.7	35000	7000	41958	39124	0.223	0.777	2.225	1.620	0.280	0.872	2.803	20607	12858	0.436	16718	4189
Rule B	0.6	ticker	0.8	35000	7000	40215	39052	0.244	0.771	2.440	1.747	0.296	0.890	2.963	20874	12953	0.431	16884	4190
Rule B	0.6	ticker	0.9	35000	7000	38773	38838	0.253	0.785	2.531	1.759	0.303	0.893	3.031	21007	13184	0.423	16787	4220
Rule B	0.6	ticker	1	35000	7000	38567	38161	0.269	0.789	2.691	1.845	0.299	0.877	2.994	21253	13182	0.409	16980	4273

HCR	Allocat % Spain	SR	HR	TAC_{max}	TAC_{min}	Median SSB	Median SSB_{last}	$P(SSB<B_{lim})$	$P(SSB<B_{lim})$ once)	Nb years $SSB<B_{lim}$	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule B	0.7	ricker	0.1	no	no	74714	77000	0.013	0.092	0.125	0.119	0.026	0.189	0.257	8469	5303	1.626	5943	2547
Rule B	0.7	ricker	0.2	no	no	62185	65551	0.034	0.204	0.341	0.294	0.054	0.334	0.543	14509	10154	2.170	10156	4353
Rule B	0.7	ricker	0.3	no	no	53631	56626	0.070	0.378	0.703	0.592	0.087	0.499	0.873	19206	14672	2.513	13529	5798
Rule B	0.7	ricker	0.4	no	no	45914	44885	0.132	0.606	1.321	1.064	0.138	0.647	1.380	22376	19219	3.202	15680	6718
Rule B	0.7	ricker	0.5	no	no	39679	39829	0.203	0.771	2.032	1.514	0.211	0.814	2.114	24319	23138	6.770	17006	7312
Rule B	0.7	ricker	0.6	no	no	34058	33819	0.282	0.890	2.819	1.946	0.270	0.899	2.702	25425	27087	3.648	17731	7595
Rule B	0.7	ricker	0.7	no	no	28690	27239	0.363	0.953	3.626	2.382	0.341	0.957	3.408	25275	29020	3.852	17551	7724
Rule B	0.7	ricker	0.8	no	no	25078	24744	0.429	0.976	4.286	2.734	0.397	0.983	3.967	25063	30998	4.153	17289	7775
Rule B	0.7	ricker	0.9	no	no	21696	20882	0.483	0.991	4.831	2.986	0.445	0.990	4.450	24522	31947	3.899	16759	7763
Rule B	0.7	ricker	1	no	no	18654	17380	0.544	0.997	5.439	3.350	0.502	0.998	5.020	23206	32049	3.843	15746	7481
Rule B	0.7	ricker	0.1	33000	no	72691	75561	0.015	0.104	0.150	0.130	0.030	0.209	0.299	8153	4932	1.695	5707	2446
Rule B	0.7	ricker	0.2	33000	no	63080	64213	0.032	0.194	0.315	0.281	0.051	0.324	0.512	13957	8115	1.851	9770	4187
Rule B	0.7	ricker	0.3	33000	no	57537	57598	0.056	0.328	0.558	0.493	0.073	0.439	0.728	17511	9583	1.638	12258	5253
Rule B	0.7	ricker	0.4	33000	no	51765	49321	0.103	0.497	1.031	0.838	0.113	0.574	1.132	19452	10515	0.648	13016	5836
Rule B	0.7	ricker	0.5	33000	no	47392	45939	0.150	0.633	1.496	1.135	0.154	0.679	1.539	20229	11309	4.000	14159	6070
Rule B	0.7	ricker	0.6	33000	no	45012	40372	0.163	0.697	1.630	1.362	0.178	0.727	1.780	21234	11883	2.102	14859	6375
Rule B	0.7	ricker	0.7	33000	no	41344	38442	0.214	0.781	2.138	1.540	0.205	0.784	2.049	21140	12456	2.442	14788	6352
Rule B	0.7	ricker	0.8	33000	no	41526	39849	0.232	0.759	2.321	1.683	0.223	0.788	2.230	21469	12541	1.940	15013	6455
Rule B	0.7	ricker	0.9	33000	no	39646	38545	0.252	0.805	2.522	1.758	0.239	0.817	2.392	21542	12883	1.745	15057	6484
Rule B	0.7	ricker	1	33000	no	38706	35100	0.262	0.798	2.617	1.885	0.246	0.815	2.460	21606	12840	1.449	15102	6506
Rule B	0.7	ricker	0.1	no	7000	75703	79910	0.010	0.076	0.096	0.091	0.460	0.992	4.603	6462	6889	NA	4538	1945
Rule B	0.7	ricker	0.2	no	7000	63719	67750	0.025	0.157	0.245	0.226	0.194	0.787	1.943	14350	10838	0.852	10045	4305
Rule B	0.7	ricker	0.3	no	7000	54939	55585	0.061	0.350	0.614	0.530	0.190	0.905	1.895	19330	15210	0.719	13531	5799
Rule B	0.7	ricker	0.4	no	7000	47633	46014	0.115	0.580	1.153	0.929	0.236	0.669	2.359	22460	19482	0.777	15717	6743
Rule B	0.7	ricker	0.5	no	7000	40873	39701	0.191	0.748	1.913	1.450	0.300	0.932	3.004	24550	24088	0.858	17173	7378
Rule B	0.7	ricker	0.6	no	7000	33916	32754	0.282	0.890	2.819	2.009	0.368	0.982	3.681	24906	27419	0.946	17352	7564
Rule B	0.7	ricker	0.7	no	7000	28302	25585	0.363	0.940	3.630	2.322	0.424	0.990	4.242	24553	29021	0.978	17033	7519
Rule B	0.7	ricker	0.8	no	7000	25577	23197	0.421	0.979	4.213	2.670	0.458	0.997	4.578	25637	32088	1.045	17867	7970
Rule B	0.7	ricker	0.9	no	7000	22387	21194	0.479	0.984	4.786	2.967	0.500	0.992	4.995	24680	32378	1.058	16889	7791
Rule B	0.7	ricker	1	no	7000	19018	18553	0.531	0.995	5.312	3.230	0.547	0.999	5.473	23536	33015	1.065	15990	7545
Rule B	0.7	ricker	0.1	33000	7000	75694	78788	0.008	0.055	0.082	0.077	0.474	0.991	4.741	6493	6847	NA	4545	1948
Rule B	0.7	ricker	0.2	33000	7000	64407	68372	0.024	0.159	0.239	0.215	0.181	0.765	1.814	13884	8581	NA	9488	4066
Rule B	0.7	ricker	0.3	33000	7000	56850	57351	0.059	0.359	0.593	0.525	0.185	0.781	1.850	17101	10105	0.525	11970	5130
Rule B	0.7	ricker	0.4	33000	7000	50758	51693	0.102	0.505	1.019	0.832	0.217	0.820	2.170	18659	11171	0.466	13201	5658
Rule B	0.7	ricker	0.5	33000	7000	46503	49161	0.136	0.609	1.377	1.078	0.231	0.849	2.308	20305	11798	0.455	14274	6119
Rule B	0.7	ricker	0.6	33000	7000	45766	43828	0.172	0.680	1.721	1.293	0.251	0.835	2.513	20972	12148	0.440	14676	6295
Rule B	0.7	ricker	0.7	33000	7000	42563	42598	0.211	0.749	2.106	1.514	0.277	0.867	2.772	21016	12710	0.432	14702	6317
Rule B	0.7	ricker	0.8	33000	7000	40944	40039	0.227	0.770	2.268	1.626	0.286	0.867	2.859	21167	12849	0.425	14803	6364
Rule B	0.7	ricker	0.9	33000	7000	39730	37088	0.249	0.785	2.489	1.756	0.292	0.876	2.921	21291	13011	0.415	14883	6407
Rule B	0.7	ricker	1	33000	7000	39490	37926	0.252	0.814	2.524	1.829	0.295	0.889	2.948	21432	13247	0.409	14981	6451

HCR	Allocat % Spain	SR	HR	TAC_{min}	TAC_{max}	Median SSB	Median SSB_{end}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years $SSB<B_{lim}$	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule B	0.6	ricker	0.1	no	no	73691	77883	0.014	0.092	0.136	0.122	0.027	0.190	0.271	8261	5188	1.394	5029	3282
Rule B	0.6	ricker	0.2	no	no	63380	64078	0.027	0.177	0.274	0.251	0.046	0.318	0.461	14662	9842	1.575	8909	5873
Rule B	0.6	ricker	0.3	no	no	54234	55420	0.068	0.381	0.680	0.571	0.082	0.483	0.815	19044	14802	4.092	11606	7737
Rule B	0.6	ricker	0.4	no	no	45947	47050	0.132	0.602	1.317	1.043	0.139	0.696	1.390	22226	19010	2.994	13331	8895
Rule B	0.6	ricker	0.5	no	no	40361	38851	0.192	0.752	1.924	1.424	0.188	0.792	1.882	24833	23037	3.856	14708	9825
Rule B	0.6	ricker	0.6	no	no	34020	33880	0.272	0.884	2.722	1.928	0.262	0.901	2.624	25112	26307	5.956	15005	10106
Rule B	0.6	ricker	0.7	no	no	30024	28160	0.343	0.946	3.434	2.295	0.326	0.960	3.263	25004	29555	4.986	15392	10512
Rule B	0.6	ricker	0.8	no	no	24481	22772	0.437	0.979	4.373	2.772	0.402	0.974	4.024	24554	30080	4.104	14670	10084
Rule B	0.6	ricker	0.9	no	no	21917	20034	0.483	0.988	4.829	2.992	0.446	0.982	4.464	25006	32471	3.506	14580	10425
Rule B	0.6	ricker	1	no	no	18270	18044	0.548	0.992	5.478	3.376	0.502	0.998	5.018	25393	33809	4.356	13455	9937
Rule B	0.6	ricker	0.1	33000	no	73071	75033	0.013	0.092	0.132	0.121	0.029	0.208	0.289	8241	5054	2.695	4945	3296
Rule B	0.6	ricker	0.2	33000	no	64255	66880	0.032	0.204	0.318	0.288	0.046	0.301	0.455	13966	8182	6.275	8380	5586
Rule B	0.6	ricker	0.3	33000	no	56294	58411	0.066	0.382	0.658	0.571	0.079	0.461	0.788	17156	9558	3.039	10294	6863
Rule B	0.6	ricker	0.4	33000	no	50175	52274	0.110	0.534	1.102	0.883	0.117	0.596	1.174	19039	10883	4.068	11424	7616
Rule B	0.6	ricker	0.5	33000	no	46272	48380	0.137	0.612	1.368	1.055	0.139	0.648	1.390	20595	11235	2.443	12356	8239
Rule B	0.6	ricker	0.6	33000	no	43771	41575	0.166	0.720	1.660	1.396	0.182	0.726	1.822	20773	11810	NA	12461	8313
Rule B	0.6	ricker	0.7	33000	no	41416	38625	0.221	0.785	2.212	1.581	0.212	0.786	2.122	21031	12425	2.273	12908	8423
Rule B	0.6	ricker	0.8	33000	no	40164	37732	0.242	0.782	2.421	1.720	0.230	0.788	2.298	21567	12881	3.056	12905	8582
Rule B	0.6	ricker	0.9	33000	no	41019	38160	0.246	0.771	2.461	1.763	0.233	0.812	2.332	21675	12783	1.542	12989	8666
Rule B	0.6	ricker	1	33000	no	39091	37004	0.256	0.803	2.564	1.844	0.244	0.820	2.438	21551	12800	1.446	12907	8645
Rule B	0.6	ricker	0.1	no	7000	75796	79810	0.006	0.056	0.062	0.075	0.482	0.993	4.815	6441	6831	NA	3864	2576
Rule B	0.6	ricker	0.2	no	7000	63726	64043	0.026	0.179	0.277	0.249	0.188	0.751	1.878	14354	10728	0.656	8612	5742
Rule B	0.6	ricker	0.3	no	7000	54401	52847	0.064	0.358	0.640	0.544	0.197	0.793	1.972	19283	15283	0.727	11570	7713
Rule B	0.6	ricker	0.4	no	7000	47394	47001	0.120	0.580	1.201	0.981	0.238	0.882	2.379	22561	19840	0.784	13535	9025
Rule B	0.6	ricker	0.5	no	7000	40181	37804	0.195	0.754	1.948	1.472	0.297	0.934	2.987	24440	24050	0.874	14659	9781
Rule B	0.6	ricker	0.6	no	7000	34331	31910	0.270	0.886	2.696	1.884	0.352	0.970	3.524	25089	26843	NA	14992	10007
Rule B	0.6	ricker	0.7	no	7000	29470	26862	0.355	0.952	3.547	2.346	0.409	0.984	4.088	25654	29839	1.018	15241	10413
Rule B	0.6	ricker	0.8	no	7000	26038	24153	0.416	0.972	4.163	2.639	0.455	0.991	4.547	25431	31311	1.001	14996	10435
Rule B	0.6	ricker	0.9	no	7000	21559	20587	0.491	0.984	4.914	3.057	0.509	0.992	5.086	24411	32307	1.035	14250	10161
Rule B	0.6	ricker	1	no	7000	18602	17802	0.542	0.994	5.417	3.324	0.553	0.998	5.526	23265	32940	1.074	13414	9672
Rule B	0.6	ricker	0.1	33000	7000	75997	80405	0.009	0.082	0.086	0.082	0.487	0.993	4.866	6227	6885	NA	3796	2531
Rule B	0.6	ricker	0.2	33000	7000	64335	66077	0.023	0.144	0.225	0.208	0.186	0.773	1.860	13431	8504	0.562	8058	5372
Rule B	0.6	ricker	0.3	33000	7000	57558	58577	0.051	0.310	0.512	0.445	0.182	0.778	1.823	17295	10147	0.527	10377	6918
Rule B	0.6	ricker	0.4	33000	7000	50698	51162	0.100	0.488	1.000	0.814	0.210	0.804	2.095	19107	10981	0.493	11464	7643
Rule B	0.6	ricker	0.5	33000	7000	49076	48008	0.130	0.603	1.300	1.016	0.221	0.829	2.208	20723	11548	0.457	12434	8290
Rule B	0.6	ricker	0.6	33000	7000	43150	43228	0.184	0.721	1.837	1.349	0.269	0.875	2.688	20293	12472	0.462	12171	8122
Rule B	0.6	ricker	0.7	33000	7000	42558	40825	0.215	0.745	2.148	1.583	0.279	0.883	2.788	20969	12748	0.438	12569	8400
Rule B	0.6	ricker	0.8	33000	7000	40999	39739	0.228	0.764	2.277	1.624	0.288	0.879	2.878	21203	12975	0.436	12707	8496
Rule B	0.6	ricker	0.9	33000	7000	39651	39083	0.247	0.794	2.468	1.753	0.291	0.875	2.910	21326	12881	0.418	12777	8549
Rule B	0.6	ricker	1	33000	7000	39791	38540	0.256	0.771	2.577	1.820	0.296	0.886	2.958	21495	13081	0.404	12872	8622

HCR	Allocat % Spain	SR	HR	TAC_{min}	TAC_{max}	Median SSB	Median SSB_{MSY}	$P(SSB<B_{lim})$	$P(SSB<B_{lim})$ once)	Nb years $SSB<B_{lim}$	Nb years to SSB>Blim	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation	Aver catch Spain	Aver catch France
Rule B	0.5	ricker	0.1	no	no	73587	77788	0.015	0.090	0.132	0.122	0.029	0.206	0.269	8216	5932	2.581	4109	4108
Rule B	0.5	ricker	0.2	no	no	63624	68022	0.030	0.108	0.301	0.279	0.046	0.313	0.459	14617	9803	5.101	7309	7308
Rule B	0.5	ricker	0.3	no	no	54678	58883	0.065	0.385	0.645	0.550	0.078	0.451	0.780	19642	15028	9.315	9820	9822
Rule B	0.5	ricker	0.4	no	no	45931	44130	0.126	0.589	1.257	0.997	0.134	0.670	1.341	22801	19767	3.057	11401	11400
Rule B	0.5	ricker	0.5	no	no	40490	40073	0.192	0.754	1.918	1.415	0.194	0.787	1.938	24647	23353	8.056	12415	12432
Rule B	0.5	ricker	0.6	no	no	33472	32573	0.284	0.888	2.835	1.936	0.269	0.906	2.691	25049	26408	5.583	12472	12577
Rule B	0.5	ricker	0.7	no	no	28981	27336	0.361	0.937	3.606	2.370	0.339	0.935	3.392	25647	29286	6.126	12850	12697
Rule B	0.5	ricker	0.8	no	no	25038	24513	0.427	0.975	4.269	2.696	0.395	0.971	3.947	25639	32051	58.354	12847	13192
Rule B	0.5	ricker	0.9	no	no	21419	19817	0.492	0.985	4.920	3.051	0.449	0.983	4.494	24676	32469	5.090	12034	12642
Rule B	0.5	ricker	1	no	no	18607	18217	0.541	0.996	5.407	3.289	0.496	0.995	4.957	23765	33081	4.414	11378	12387
Rule B	0.5	ricker	0.1	33000	no	72269	78019	0.017	0.109	0.169	0.150	0.033	0.213	0.327	8102	4889	1.476	4051	4051
Rule B	0.5	ricker	0.2	33000	no	62427	64012	0.033	0.205	0.334	0.301	0.050	0.327	0.495	13723	7997	1.770	6861	6861
Rule B	0.5	ricker	0.3	33000	no	55915	59032	0.062	0.347	0.623	0.531	0.078	0.456	0.776	17156	9588	2.293	8578	8578
Rule B	0.5	ricker	0.4	33000	no	49644	48883	0.110	0.521	1.095	0.870	0.114	0.576	1.142	19131	10585	2.348	9565	9565
Rule B	0.5	ricker	0.5	33000	no	47392	46208	0.136	0.622	1.383	1.067	0.144	0.657	1.441	20068	11328	2.097	10193	10194
Rule B	0.5	ricker	0.6	33000	no	44177	42341	0.165	0.707	1.647	1.345	0.164	0.741	1.637	20834	11855	2.578	10413	10421
Rule B	0.5	ricker	0.7	33000	no	42045	41273	0.214	0.747	2.143	1.506	0.208	0.774	2.079	21146	12284	1.817	10567	10580
Rule B	0.5	ricker	0.8	33000	no	42022	38022	0.225	0.788	2.253	1.580	0.216	0.789	2.162	21770	12561	3.290	10878	10892
Rule B	0.5	ricker	0.9	33000	no	39762	39844	0.251	0.792	2.507	1.848	0.240	0.804	2.398	21444	12823	1.551	10705	10738
Rule B	0.5	ricker	1	33000	no	39078	37001	0.261	0.788	2.605	1.882	0.244	0.800	2.438	21700	12882	1.772	10832	10867
Rule B	0.5	ricker	0.1	no	7000	76505	78883	0.006	0.054	0.061	0.076	0.477	0.988	4.768	6537	6822	NA	3269	3269
Rule B	0.5	ricker	0.2	no	7000	62871	64703	0.025	0.161	0.254	0.235	0.194	0.784	1.941	14174	10540	0.650	7087	7087
Rule B	0.5	ricker	0.3	no	7000	54650	54319	0.064	0.372	0.644	0.536	0.196	0.810	1.961	19110	15103	0.724	9555	9555
Rule B	0.5	ricker	0.4	no	7000	46823	48931	0.115	0.573	1.153	0.936	0.236	0.883	2.356	22179	19119	0.788	11089	11093
Rule B	0.5	ricker	0.5	no	7000	40285	39717	0.191	0.740	1.907	1.428	0.256	0.930	2.561	24309	23578	0.880	12139	12170
Rule B	0.5	ricker	0.6	no	7000	34627	30808	0.277	0.885	2.765	1.924	0.349	0.969	3.489	25455	26855	0.925	12847	12808
Rule B	0.5	ricker	0.7	no	7000	29045	28472	0.356	0.941	3.577	2.460	0.423	0.983	4.227	25494	30041	0.988	12575	12920
Rule B	0.5	ricker	0.8	no	7000	25248	24830	0.423	0.988	4.230	2.704	0.463	0.988	4.631	25200	31237	1.023	12359	12841
Rule B	0.5	ricker	0.9	no	7000	22030	20747	0.484	0.986	4.843	3.037	0.506	0.998	5.076	24686	32929	1.037	12004	12882
Rule B	0.5	ricker	1	no	7000	18408	17167	0.547	0.994	5.468	3.314	0.555	0.999	5.550	24331	34658	1.067	11617	12715
Rule B	0.5	ricker	0.1	33000	7000	76309	82869	0.010	0.088	0.098	0.089	0.482	0.992	4.815	6363	6523	NA	3182	3182
Rule B	0.5	ricker	0.2	33000	7000	64403	68591	0.024	0.150	0.240	0.215	0.181	0.785	1.812	13502	8578	NA	6751	6751
Rule B	0.5	ricker	0.3	33000	7000	57548	58505	0.052	0.314	0.518	0.426	0.181	0.769	1.810	17361	10085	0.519	8680	8680
Rule B	0.5	ricker	0.4	33000	7000	50633	48044	0.100	0.500	1.002	0.815	0.215	0.808	2.150	18881	10938	NA	9440	9441
Rule B	0.5	ricker	0.5	33000	7000	46296	47839	0.139	0.629	1.390	1.098	0.234	0.857	2.343	20379	11884	0.460	10188	10190
Rule B	0.5	ricker	0.6	33000	7000	44700	44187	0.179	0.695	1.794	1.319	0.256	0.855	2.559	20882	12233	0.453	10422	10430
Rule B	0.5	ricker	0.7	33000	7000	43311	43048	0.200	0.722	1.998	1.453	0.265	0.849	2.649	21342	12298	0.457	10666	10678
Rule B	0.5	ricker	0.8	33000	7000	42917	42381	0.216	0.753	2.161	1.551	0.270	0.873	2.703	21674	12788	0.406	10824	10850
Rule B	0.5	ricker	0.9	33000	7000	39640	38859	0.245	0.795	2.453	1.710	0.297	0.893	2.968	21200	13292	NA	10587	10613
Rule B	0.5	ricker	1	33000	7000	39067	35978	0.263	0.794	2.632	1.825	0.299	0.896	2.991	21317	12929	0.418	10645	10672

8. Appendix III

Appendix III. Summary results of the evaluation of the proposed HCRs using an age-structured model.

HCR	Allocat	SR	HR	ITERS	TAC_{max}	TAC_{min}	Median SSB	Median SSB_{last}	$P(SSB<B_{lim})$	$P(SSB<B_{lim})$ once)	Nb years $SSB<B_{lim}$	Nb years to $SSB<SSB_{lim}$	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation
Rule A	sta	rober	0	100	no	no	97.988	99.251	0.01	0.05	0.07	0.07	1.00	1.00	10.00	0.000	0.00	NA
Rule A	sta	rober	0.1	100	no	no	82.048	75.417	0.03	0.03	0.03	0.03	0.02	0.20	0.23	4.947	5.55	1.84
Rule A	sta	rober	0.2	500	no	no	87.967	84.844	0.01	0.04	0.05	0.05	0.03	0.26	0.33	9.197	7.05	2.02
Rule A	sta	rober	0.3	500	no	no	90.068	92.557	0.01	0.05	0.05	0.05	0.03	0.24	0.30	12.736	10.09	2.62
Rule A	sta	rober	0.4	500	no	no	91.894	95.468	0.01	0.09	0.10	0.09	0.04	0.30	0.39	15.896	13.41	3.27
Rule A	sta	rober	0.5	500	no	no	49.963	51.589	0.03	0.10	0.20	0.24	0.06	0.40	0.59	19.906	16.61	3.48
Rule A	sta	rober	0.6	500	no	no	46.793	49.069	0.04	0.29	0.42	0.56	0.07	0.60	0.69	21.936	19.02	4.56
Rule A	sta	rober	0.7	500	no	no	43.973	42.718	0.07	0.45	0.65	0.53	0.10	0.82	0.87	22.971	21.99	5.78
Rule A	sta	rober	0.8	500	no	no	41.439	42.035	0.10	0.60	0.98	0.72	0.12	0.70	1.22	24.322	24.12	6.20
Rule A	sta	rober	0.9	100	no	no	37.393	39.227	0.13	0.69	1.34	0.96	0.17	0.81	1.67	24.278	24.65	4.40
Rule A	sta	rober	1	100	no	no	34.594	38.717	0.15	0.72	1.33	0.79	0.15	0.79	1.51	27.527	27.30	4.24
Rule A	sta	rober	0	100	33.000	no	97.981	76.003	0.01	0.03	0.05	0.05	1.00	1.00	10.00	0.000	0.00	NA
Rule A	sta	rober	0.1	100	33.000	no	80.021	70.013	0.01	0.05	0.07	0.07	0.02	0.15	0.19	4.744	5.51	5.94
Rule A	sta	rober	0.2	500	33.000	no	59.757	65.423	0.01	0.04	0.05	0.06	0.02	0.19	0.24	9.329	6.97	2.60
Rule A	sta	rober	0.3	500	33.000	no	56.317	59.751	0.01	0.06	0.07	0.07	0.03	0.24	0.32	12.911	9.21	2.66
Rule A	sta	rober	0.4	500	33.000	no	53.005	59.002	0.01	0.09	0.10	0.10	0.04	0.31	0.40	15.997	10.64	3.19
Rule A	sta	rober	0.5	500	33.000	no	52.407	59.077	0.02	0.15	0.20	0.19	0.05	0.36	0.47	18.930	11.19	2.93
Rule A	sta	rober	0.6	500	33.000	no	50.014	52.483	0.03	0.19	0.27	0.24	0.06	0.40	0.58	19.175	11.66	2.17
Rule A	sta	rober	0.7	500	33.000	no	48.019	51.393	0.04	0.29	0.45	0.37	0.07	0.47	0.71	19.041	12.06	2.37
Rule A	sta	rober	0.8	500	33.000	no	47.001	49.749	0.06	0.39	0.59	0.44	0.09	0.57	0.92	19.458	12.61	2.84
Rule A	sta	rober	0.9	100	33.000	no	46.403	55.793	0.09	0.50	0.81	0.67	0.10	0.68	0.98	20.266	12.61	2.74
Rule A	sta	rober	1	100	33.000	no	41.949	44.583	0.07	0.41	0.73	0.52	0.11	0.67	1.08	20.276	12.78	2.07
Rule A	sta	rober	0	100	no	7.000	86.741	75.773	0.01	0.05	0.06	0.06	1.00	1.00	10.00	0.000	0.00	NA
Rule A	sta	rober	0.1	100	no	7.000	83.188	70.275	0.01	0.04	0.05	0.05	0.75	1.00	7.64	2.536	4.41	0.69
Rule A	sta	rober	0.2	500	no	7.000	80.194	64.485	0.03	0.01	0.02	0.02	0.45	1.00	4.53	7.941	8.58	0.69
Rule A	sta	rober	0.3	500	no	7.000	57.573	61.369	0.03	0.03	0.04	0.03	0.33	0.96	3.32	12.399	11.84	0.72
Rule A	sta	rober	0.4	500	no	7.000	52.122	55.951	0.01	0.06	0.07	0.07	0.29	0.96	2.90	15.516	14.35	0.81
Rule A	sta	rober	0.5	500	no	7.000	49.715	53.444	0.02	0.14	0.19	0.19	0.27	0.94	2.70	18.378	17.05	0.88
Rule A	sta	rober	0.6	500	no	7.000	46.988	49.047	0.03	0.25	0.33	0.30	0.27	0.93	2.71	20.212	19.07	0.94
Rule A	sta	rober	0.7	500	no	7.000	44.752	46.579	0.07	0.42	0.69	0.53	0.29	0.94	2.76	22.450	22.07	0.98
Rule A	sta	rober	0.8	500	no	7.000	42.323	43.809	0.09	0.57	0.99	0.89	0.29	0.95	2.88	24.137	25.00	1.07
Rule A	sta	rober	0.9	100	no	7.000	39.008	37.251	0.12	0.69	1.24	0.94	0.30	0.96	3.03	25.430	27.77	1.21
Rule A	sta	rober	1	100	no	7.000	39.253	39.589	0.14	0.77	1.30	0.94	0.30	0.97	2.99	26.518	29.07	1.08
Rule A	sta	rober	0	100	33.000	7.000	83.770	76.722	0.01	0.05	0.07	0.07	1.00	1.00	10.00	0.000	0.00	NA
Rule A	sta	rober	0.1	100	33.000	7.000	71.133	61.797	0.03	0.02	0.04	0.04	0.70	1.00	7.01	3.216	5.05	0.75
Rule A	sta	rober	0.2	500	33.000	7.000	60.061	65.009	0.03	0.03	0.03	0.03	0.46	0.96	4.51	8.019	8.56	0.64
Rule A	sta	rober	0.3	500	33.000	7.000	57.491	59.215	0.03	0.04	0.04	0.04	0.33	0.97	3.29	11.914	10.28	0.69
Rule A	sta	rober	0.4	500	33.000	7.000	54.738	58.775	0.01	0.06	0.06	0.06	0.29	0.92	2.75	14.479	11.48	0.66
Rule A	sta	rober	0.5	500	33.000	7.000	51.085	57.458	0.01	0.11	0.13	0.13	0.26	0.92	2.47	16.232	11.66	0.65
Rule A	sta	rober	0.6	500	33.000	7.000	51.368	57.151	0.02	0.19	0.24	0.22	0.25	0.97	2.29	17.997	12.50	0.62
Rule A	sta	rober	0.7	500	33.000	7.000	49.153	51.585	0.04	0.27	0.39	0.33	0.22	0.97	2.18	18.782	12.68	0.60
Rule A	sta	rober	0.8	500	33.000	7.000	48.024	52.588	0.04	0.30	0.39	0.33	0.22	0.96	2.19	19.827	12.93	0.59
Rule A	sta	rober	0.9	100	33.000	7.000	47.098	52.461	0.05	0.33	0.49	0.39	0.21	0.94	2.14	20.448	13.06	0.58
Rule A	sta	rober	1	100	33.000	7.000	47.529	50.529	0.05	0.34	0.49	0.39	0.21	0.94	2.07	20.919	12.91	0.53

Appendix III. Summary results of the evaluation of the proposed HCRs using an age-structured model.

HCR	Allocat	SR	HR	ITERS	TAC_{bank}	TAC_{sub}	Median SSB	Median SSB_{ave}	P(SSB<B_{lim})	P(SSB<B_{lim}) once)	Nb years SSB<B_{lim}	Nb years to SSB>B_{lim}	P(closure)	P(closure once)	Nb years closure	Average catch	Average sd catch	Interannual catch variation
Rule 0	cte	ricker	0	100	no	no	67.996	79.809	0.00	0.02	0.04	0.04	1.00	1.00	10.00	0.000	0.00	NA
Rule 0	cte	ricker	0.1	500	no	no	62.899	69.468	0.00	0.03	0.04	0.04	0.02	0.19	0.20	6.871	3.91	1.47
Rule 0	cte	ricker	0.2	500	no	no	58.229	64.117	0.01	0.09	0.12	0.11	0.03	0.25	0.34	12.585	7.66	2.37
Rule 0	cte	ricker	0.3	500	no	no	51.472	52.020	0.02	0.18	0.33	0.19	0.06	0.38	0.56	17.137	11.37	3.66
Rule 0	cte	ricker	0.4	500	no	no	46.625	47.012	0.05	0.34	0.49	0.42	0.09	0.55	0.80	20.452	14.67	4.63
Rule 0	cte	ricker	0.5	500	no	no	42.984	42.066	0.09	0.54	0.82	0.69	0.12	0.67	1.16	23.610	18.40	11.32
Rule 0	cte	ricker	0.6	500	no	no	39.890	38.945	0.14	0.70	1.58	0.87	0.18	0.76	1.80	26.206	21.66	6.69
Rule 0	cte	ricker	0.7	100	no	no	35.714	34.000	0.22	0.87	2.19	1.13	0.23	0.91	2.29	25.810	24.21	3.98
Rule 0	cte	ricker	0.8	100	no	no	33.349	29.567	0.25	0.93	2.49	1.22	0.27	0.92	2.86	26.679	29.02	2.86
Rule 0	cte	ricker	0.9	100	no	no	33.993	33.938	0.28	0.94	2.84	1.19	0.27	0.90	2.74	30.533	30.06	3.00
Rule 0	cte	ricker	1	100	no	no	31.439	28.496	0.31	0.95	3.06	1.27	0.33	0.90	3.27	31.291	32.49	7.02
Rule 0	cte	ricker	0	100	33.030	no	68.268	71.494	0.00	0.04	0.04	0.04	1.00	1.00	10.00	0.000	0.00	NA
Rule 0	cte	ricker	0.1	500	33.030	no	64.825	66.908	0.00	0.04	0.05	0.05	0.02	0.21	0.25	6.855	3.79	2.34
Rule 0	cte	ricker	0.2	500	33.030	no	58.171	64.478	0.01	0.07	0.10	0.09	0.03	0.26	0.35	12.362	7.26	1.76
Rule 0	cte	ricker	0.3	500	33.030	no	53.130	55.441	0.03	0.18	0.25	0.21	0.06	0.41	0.58	15.899	9.57	4.25
Rule 0	cte	ricker	0.4	500	33.030	no	48.461	53.598	0.04	0.33	0.45	0.36	0.09	0.49	0.77	19.023	11.01	4.40
Rule 0	cte	ricker	0.5	500	33.030	no	45.156	49.554	0.09	0.48	0.77	0.55	0.11	0.60	1.09	20.471	11.95	2.91
Rule 0	cte	ricker	0.6	500	33.030	no	44.896	45.261	0.13	0.54	0.95	0.67	0.12	0.66	1.21	21.846	12.50	4.09
Rule 0	cte	ricker	0.7	100	33.030	no	44.819	45.219	0.13	0.69	1.29	0.83	0.15	0.77	1.47	22.094	13.24	4.12
Rule 0	cte	ricker	0.8	100	33.030	no	42.475	47.484	0.13	0.65	1.33	0.84	0.14	0.68	1.39	23.056	13.18	3.73
Rule 0	cte	ricker	0.9	100	33.030	no	41.766	39.139	0.17	0.71	1.69	1.00	0.17	0.74	1.73	22.940	13.65	1.47
Rule 0	cte	ricker	1	100	33.030	no	43.257	49.344	0.14	0.73	1.41	0.91	0.17	0.91	1.89	23.993	13.71	2.12
Rule 0	cte	ricker	0	100	no	7.000	71.873	74.378	0.01	0.04	0.07	0.07	1.00	1.00	10.00	0.000	0.00	NA
Rule 0	cte	ricker	0.1	500	no	7.000	69.360	72.529	0.00	0.03	0.04	0.04	0.59	1.00	5.75	4.500	5.41	0.00
Rule 0	cte	ricker	0.2	500	no	7.000	57.491	66.727	0.01	0.05	0.06	0.06	0.20	0.94	2.02	12.191	9.44	0.55
Rule 0	cte	ricker	0.3	500	no	7.000	51.252	52.651	0.02	0.17	0.33	0.20	0.19	0.85	1.96	16.840	12.02	0.91
Rule 0	cte	ricker	0.4	500	no	7.000	48.393	50.260	0.05	0.32	0.47	0.29	0.20	0.85	1.98	20.173	14.85	0.85
Rule 0	cte	ricker	0.5	500	no	7.000	44.049	44.977	0.09	0.55	0.88	0.88	0.23	0.91	2.26	23.710	18.89	0.75
Rule 0	cte	ricker	0.6	500	no	7.000	39.466	39.400	0.14	0.69	1.58	0.96	0.27	0.94	2.88	25.346	21.75	0.93
Rule 0	cte	ricker	0.7	100	no	7.000	35.244	36.567	0.23	0.81	1.96	1.04	0.33	0.89	3.33	25.796	25.19	0.92
Rule 0	cte	ricker	0.8	100	no	7.000	33.961	33.064	0.23	0.91	2.29	1.16	0.34	0.89	3.35	27.547	29.72	0.96
Rule 0	cte	ricker	0.9	100	no	7.000	33.868	27.360	0.25	0.87	2.50	1.22	0.34	1.00	3.40	30.196	29.35	1.00
Rule 0	cte	ricker	1	100	no	7.000	28.872	29.509	0.35	0.89	3.52	1.40	0.42	1.00	4.21	27.849	30.62	1.06
Rule 0	cte	ricker	0	100	33.030	7.000	70.364	74.582	0.00	0.03	0.04	0.03	1.00	1.00	10.00	0.000	0.00	NA
Rule 0	cte	ricker	0.1	500	33.030	7.000	62.261	70.927	0.00	0.03	0.03	0.03	0.59	1.00	5.80	4.520	5.52	0.01
Rule 0	cte	ricker	0.2	500	33.030	7.000	54.429	59.634	0.01	0.07	0.08	0.08	0.22	0.96	2.18	11.525	8.06	0.58
Rule 0	cte	ricker	0.3	500	33.030	7.000	52.526	59.534	0.02	0.15	0.31	0.19	0.19	0.79	1.75	16.347	10.15	0.55
Rule 0	cte	ricker	0.4	500	33.030	7.000	47.871	52.590	0.05	0.32	0.46	0.37	0.20	0.85	1.97	19.472	11.55	0.53
Rule 0	cte	ricker	0.5	500	33.030	7.000	48.869	50.533	0.07	0.42	0.69	0.51	0.20	0.85	2.04	20.594	12.37	0.49
Rule 0	cte	ricker	0.6	500	33.030	7.000	43.583	45.558	0.10	0.55	0.97	0.69	0.22	0.89	2.20	21.362	13.04	0.49
Rule 0	cte	ricker	0.7	100	33.030	7.000	45.551	48.827	0.11	0.61	1.09	0.74	0.20	0.80	1.99	23.291	13.01	0.41
Rule 0	cte	ricker	0.8	100	33.030	7.000	43.176	49.928	0.12	0.62	1.24	0.75	0.22	0.86	2.22	23.076	13.66	0.42
Rule 0	cte	ricker	0.9	100	33.030	7.000	41.548	43.554	0.15	0.69	1.51	0.87	0.23	0.85	2.34	22.919	14.00	0.43
Rule 0	cte	ricker	1	100	33.030	7.000	39.779	39.434	0.19	0.77	1.91	1.07	0.25	0.87	2.53	22.516	14.18	0.43

9. Appendix IV. Economic analysis: performance of the two basic HCRs for different quota allocation schemes.

Constant allocation

HCR	Case	Gamma	GR_an	Cash	oach_SP_PS	oach_FR_PS	oach_FR_PL	Prob_oach0_SP_P	Prob_oach0_FR_P	Prob_oach0_FR_P	SoInd_SP_PS	SoInd_SI_FR_PS	SoInd_FR_PL
RULE A	a	0.1	240958	327460	215913	16314	91234	0.03	0.02	0.01	1.10	1.19	2.34
RULE A	a	0.2	330387	316908	209888	16034	90986	0.03	0.02	0.01	1.07	1.18	2.34
RULE A	a	0.3	372794	293033	193715	15108	84210	0.04	0.05	0.04	1.02	1.14	2.25
RULE A	a	0.4	392755	267036	176483	13864	76689	0.07	0.08	0.07	0.98	1.11	2.13
RULE A	a	0.5	408792	243650	160558	13067	70025	0.10	0.13	0.12	0.95	1.07	2.03
RULE A	a	0.6	404776	224645	149805	11853	62986	0.15	0.17	0.15	0.91	1.04	1.93
RULE A	a	0.7	408124	206047	137189	11128	57731	0.19	0.21	0.19	0.89	1.01	1.87
RULE A	a	0.8	402754	185080	124037	10082	50961	0.21	0.25	0.21	0.85	0.99	1.77
RULE A	a	0.9	411843	164594	109686	8985	45923	0.25	0.28	0.24	0.82	0.95	1.68
RULE A	a	1	402811	152286	104007	8172	40107	0.27	0.31	0.27	0.80	0.92	1.60
RULE A	b	0.1	233151	325942	220169	16422	89351	0.03	0.02	0.01	1.09	1.19	2.33
RULE A	b	0.2	335457	324960	214639	16467	93854	0.02	0.02	0.00	1.08	1.19	2.39
RULE A	b	0.3	390846	306313	201207	15566	89540	0.03	0.03	0.01	1.05	1.16	2.31
RULE A	b	0.4	430105	292366	191851	15060	85455	0.03	0.04	0.02	1.02	1.14	2.25
RULE A	b	0.5	452930	274228	179784	14514	79930	0.04	0.05	0.03	0.99	1.12	2.18
RULE A	b	0.6	469568	259401	169546	13599	76255	0.06	0.08	0.05	0.97	1.10	2.12
RULE A	b	0.7	475408	249706	163852	13206	72648	0.07	0.09	0.06	0.95	1.08	2.07
RULE A	b	0.8	484085	240546	158419	12785	69343	0.09	0.11	0.08	0.93	1.07	2.01
RULE A	b	0.9	490968	229633	151495	12232	66907	0.10	0.13	0.08	0.92	1.05	1.98
RULE A	b	1	495375	227793	149638	12029	66127	0.11	0.15	0.09	0.91	1.05	1.97
RULE A	c	0.1	364847	362254	235176	17965	109123	0.02	0.02	0.00	1.13	1.24	2.60
RULE A	c	0.2	410064	335881	217635	16636	101611	0.02	0.02	0.01	1.08	1.20	2.49
RULE A	c	0.3	431577	296243	191771	15193	89279	0.04	0.05	0.05	1.02	1.15	2.32
RULE A	c	0.4	444408	263935	170582	13911	79442	0.08	0.09	0.09	0.97	1.10	2.17
RULE A	c	0.5	449924	231122	150040	12232	68850	0.13	0.16	0.15	0.92	1.04	2.02
RULE A	c	0.6	446547	200180	130306	10976	58898	0.17	0.22	0.20	0.87	1.00	1.87
RULE A	c	0.7	446720	173230	114878	9265	49087	0.21	0.26	0.23	0.83	0.96	1.74
RULE A	c	0.8	444637	154558	103072	8531	42955	0.25	0.29	0.26	0.80	0.93	1.64
RULE A	c	0.9	443215	128782	88573	7129	33080	0.29	0.35	0.30	0.76	0.89	1.47
RULE A	c	1	439465	111344	76780	6027	28537	0.33	0.37	0.33	0.73	0.85	1.39
RULE A	d	0.1	364488	364717	235567	18397	110754	0.01	0.01	0.00	1.14	1.24	2.61
RULE A	d	0.2	416025	338314	217945	17009	103360	0.02	0.02	0.00	1.09	1.21	2.52
RULE A	d	0.3	447463	315034	203532	16015	95487	0.02	0.02	0.01	1.05	1.17	2.40
RULE A	d	0.4	470547	291477	188194	15135	88148	0.04	0.04	0.02	1.01	1.15	2.30
RULE A	d	0.5	482042	273920	177196	14112	82611	0.04	0.05	0.04	0.98	1.11	2.21
RULE A	d	0.6	489535	254967	163273	13515	78179	0.06	0.08	0.06	0.95	1.09	2.15
RULE A	d	0.7	494440	245888	159495	12779	73613	0.08	0.11	0.07	0.94	1.07	2.09
RULE A	d	0.8	499208	228644	146800	12222	69622	0.09	0.13	0.09	0.91	1.05	2.03
RULE A	d	0.9	500819	219417	142161	11759	65497	0.11	0.15	0.09	0.90	1.04	1.99
RULE A	d	1	504887	214643	138818	11421	64404	0.11	0.17	0.10	0.89	1.02	1.96
RULE B	a	0.1	285533	333711	222394	16647	94671	0.02	0.02	0.00	1.09	1.20	2.40
RULE B	a	0.2	393454	309065	202769	15958	90339	0.03	0.03	0.01	1.05	1.17	2.34
RULE B	a	0.3	435463	263294	172907	13919	76469	0.06	0.08	0.07	0.98	1.10	2.14
RULE B	a	0.4	456917	212663	141726	11344	59594	0.13	0.17	0.15	0.89	1.02	1.89
RULE B	a	0.5	462536	160244	108385	8946	42913	0.22	0.27	0.23	0.81	0.94	1.62
RULE B	a	0.6	460547	121088	84942	6428	29718	0.28	0.35	0.28	0.75	0.86	1.41
RULE B	a	0.7	452262	83201	58326	3908	20967	0.35	0.42	0.33	0.69	0.78	1.25
RULE B	a	0.8	443254	50927	35012	894	15021	0.42	0.48	0.38	0.63	0.67	1.16
RULE B	a	0.9	426751	14885	8065	-1903	8723	0.48	0.53	0.43	0.57	0.56	1.09
RULE B	a	1	412076	-18093	-15001	-5420	2328	0.52	0.57	0.47	0.52	0.43	1.03
RULE B	b	0.1	290665	333158	221301	16788	95069	0.02	0.02	0.00	1.10	1.20	2.39
RULE B	b	0.2	399825	317636	207466	16251	93919	0.03	0.02	0.01	1.06	1.18	2.38
RULE B	b	0.3	452621	279974	182313	14513	83048	0.04	0.04	0.03	1.00	1.13	2.22
RULE B	b	0.4	481363	247428	160625	13264	73538	0.07	0.09	0.06	0.95	1.08	2.08
RULE B	b	0.5	495909	226123	147904	11946	66274	0.10	0.14	0.09	0.91	1.04	1.96
RULE B	b	0.6	504132	210386	138152	11035	61198	0.14	0.18	0.11	0.88	1.01	1.90
RULE B	b	0.7	506603	193148	126525	10542	56082	0.17	0.21	0.13	0.86	1.00	1.82
RULE B	b	0.8	508902	180527	119452	9703	51372	0.19	0.24	0.14	0.84	0.97	1.75
RULE B	b	0.9	510670	174309	114619	9577	50113	0.20	0.25	0.14	0.83	0.96	1.74
RULE B	b	1	510484	169639	112753	9064	47822	0.21	0.27	0.15	0.82	0.95	1.71
RULE B	c	0.1	364160	358943	233785	17743	107415	0.02	0.01	0.00	1.12	1.23	2.58
RULE B	c	0.2	417213	313851	203761	16171	93920	0.02	0.02	0.01	1.05	1.18	2.39
RULE B	c	0.3	450897	260752	169216	13861	77675	0.07	0.08	0.08	0.97	1.10	2.15
RULE B	c	0.4	469796	204396	134493	11115	58788	0.14	0.18	0.17	0.88	1.01	1.86
RULE B	c	0.5	478712	140424	95675	7667	37083	0.24	0.30	0.25	0.78	0.90	1.61
RULE B	c	0.6	475495	91772	64207	4797	22767	0.32	0.39	0.32	0.70	0.81	1.27
RULE B	c	0.7	471204	48964	34071	948	13945	0.41	0.48	0.38	0.63	0.68	1.16
RULE B	c	0.8	457734	17952	12299	-2551	8203	0.47	0.54	0.43	0.57	0.55	1.09
RULE B	c	0.9	444993	-26961	-20468	-6958	465	0.54	0.60	0.49	0.50	0.36	1.00
RULE B	c	1	434860	-57066	-45804	-8991	-2272	0.58	0.63	0.52	0.43	0.28	0.95
RULE B	d	0.1	366590	363137	236485	18001	108651	0.01	0.01	0.00	1.13	1.24	2.59
RULE B	d	0.2	421575	320672	206834	16409	97429	0.02	0.02	0.00	1.06	1.19	2.44
RULE B	d	0.3	468846	281617	180751	14452	86414	0.04	0.05	0.03	0.99	1.13	2.26
RULE B	d	0.4	491737	246134	158198	13180	74756	0.07	0.09	0.07	0.94	1.08	2.11
RULE B	d	0.5	502385	211253	138253	11300	61699	0.12	0.15	0.11	0.89	1.02	1.92
RULE B	d	0.6	508288	189566	124305	10387	54874	0.15	0.20	0.13	0.85	0.99	1.82
RULE B	d	0.7	513162	182013	119639	9742	52631	0.18	0.23	0.13	0.84	0.97	1.79
RULE B	d	0.8	513518	166353	110467	8971	46914	0.20	0.26	0.15	0.81	0.94	1.70
RULE B	d	0.9	514250	167699	110111	9038	48549	0.21	0.27	0.15	0.81	0.94	1.69
RULE B	d	1	514738	151572	99725	8269	43578	0.23	0.29	0.16	0.80	0.93	1.62

Variable Allocation

HCR	Case	Gamma	GR_an	Cash	cash_SP_PS	cash_FR_PS	cash_FR_PL	Prob_cash0_SP_P	Prob_cash0_FR_P	Prob_cash0_FR_P	SocInd_SP_PS	SocInd_SI_FR_PS	SocInd_FR_PL
RULE A	a	0.1	229126	315432	234270	14470	66692	0.02	0.04	0.03	1.13	1.13	1.98
RULE A	a	0.2	322918	307580	220751	14844	71985	0.02	0.04	0.02	1.09	1.14	2.06
RULE A	a	0.3	371993	284736	199338	14410	70987	0.04	0.05	0.03	1.04	1.12	2.04
RULE A	a	0.4	390631	267322	178496	13789	65037	0.07	0.07	0.06	0.98	1.10	1.95
RULE A	a	0.5	398467	230496	157359	12749	60387	0.11	0.10	0.10	0.93	1.07	1.89
RULE A	a	0.6	402173	208205	140331	12253	55621	0.15	0.14	0.14	0.89	1.05	1.82
RULE A	a	0.7	402433	194944	130625	11446	52873	0.17	0.17	0.16	0.86	1.03	1.78
RULE A	a	0.8	406925	174448	115199	10667	48583	0.21	0.21	0.20	0.83	1.00	1.72
RULE A	a	0.9	401172	161491	106848	9988	44656	0.25	0.23	0.23	0.80	0.98	1.68
RULE A	a	1	404990	145340	95814	9224	40302	0.27	0.26	0.25	0.78	0.96	1.61
RULE A	b	0.1	231295	319297	237737	14400	67161	0.02	0.04	0.02	1.13	1.13	1.99
RULE A	b	0.2	328672	313414	224353	15096	73965	0.02	0.04	0.02	1.10	1.14	2.09
RULE A	b	0.3	383197	294597	206784	14863	72951	0.02	0.03	0.02	1.06	1.14	2.07
RULE A	b	0.4	429229	275398	188020	14653	72725	0.03	0.04	0.02	1.02	1.13	2.07
RULE A	b	0.5	455376	262964	178109	14397	70459	0.04	0.05	0.03	0.98	1.12	2.04
RULE A	b	0.6	468448	250616	168007	13900	68709	0.06	0.06	0.04	0.96	1.10	2.01
RULE A	b	0.7	479848	237921	157896	13453	66572	0.07	0.08	0.06	0.93	1.09	1.98
RULE A	b	0.8	486154	226467	150143	13128	63196	0.08	0.09	0.07	0.91	1.08	1.94
RULE A	b	0.9	491272	218812	143338	12732	62742	0.09	0.10	0.07	0.90	1.07	1.93
RULE A	b	1	494961	210792	137431	12329	61033	0.10	0.11	0.08	0.88	1.06	1.90
RULE A	c	0.1	358615	347979	252075	16070	79835	0.01	0.03	0.01	1.18	1.17	2.18
RULE A	c	0.2	405381	318427	223632	15378	79417	0.02	0.03	0.01	1.11	1.15	2.17
RULE A	c	0.3	427889	284257	194836	14789	74632	0.04	0.04	0.03	1.02	1.13	2.10
RULE A	c	0.4	442616	248169	165378	14007	68783	0.08	0.07	0.07	0.95	1.10	2.01
RULE A	c	0.5	446367	214571	140442	12664	61475	0.13	0.11	0.11	0.89	1.06	1.91
RULE A	c	0.6	448012	191080	124572	11658	54850	0.17	0.16	0.16	0.85	1.03	1.83
RULE A	c	0.7	447326	166287	106237	10508	49543	0.21	0.20	0.19	0.80	0.99	1.74
RULE A	c	0.8	444069	147825	93580	9958	44287	0.26	0.23	0.23	0.77	0.98	1.66
RULE A	c	0.9	441431	124866	78475	8717	37664	0.30	0.28	0.28	0.73	0.94	1.56
RULE A	c	1	443168	113578	71842	7791	33945	0.33	0.31	0.31	0.71	0.92	1.53
RULE A	d	0.1	358653	356450	258794	15802	81854	0.01	0.04	0.01	1.19	1.17	2.20
RULE A	d	0.2	408703	323614	225612	15851	82151	0.01	0.03	0.01	1.11	1.17	2.21
RULE A	d	0.3	449624	300475	204804	15330	80342	0.02	0.03	0.01	1.05	1.15	2.18
RULE A	d	0.4	468426	278244	186342	14732	77170	0.03	0.04	0.02	1.00	1.13	2.13
RULE A	d	0.5	481790	269824	171847	14177	73799	0.05	0.05	0.03	0.97	1.11	2.08
RULE A	d	0.6	489547	245180	161396	13831	69952	0.06	0.06	0.04	0.94	1.10	2.04
RULE A	d	0.7	494248	230480	149466	13481	67534	0.07	0.07	0.06	0.91	1.09	1.99
RULE A	d	0.8	499832	223311	143882	13105	66324	0.09	0.09	0.07	0.90	1.08	1.99
RULE A	d	0.9	501921	211311	134978	12518	63815	0.10	0.11	0.08	0.87	1.07	1.95
RULE A	d	1	504764	203104	129603	12246	61254	0.12	0.13	0.09	0.86	1.05	1.91
RULE B	a	0.1	284673	321289	235564	14939	70787	0.01	0.04	0.02	1.13	1.14	2.04
RULE B	a	0.2	387299	297210	208146	15005	74058	0.02	0.03	0.02	1.06	1.14	2.09
RULE B	a	0.3	429461	246723	165874	13777	67073	0.06	0.06	0.05	0.95	1.10	1.98
RULE B	a	0.4	454223	204045	133942	12207	57895	0.13	0.12	0.12	0.87	1.05	1.84
RULE B	a	0.5	459356	156040	100576	10288	45176	0.22	0.20	0.19	0.79	0.99	1.67
RULE B	a	0.6	461716	117298	75090	8320	33887	0.29	0.28	0.27	0.73	0.93	1.51
RULE B	a	0.7	462519	88689	56392	6708	25589	0.35	0.35	0.33	0.68	0.87	1.37
RULE B	a	0.8	439672	53591	32820	4159	16612	0.42	0.41	0.39	0.63	0.79	1.22
RULE B	a	0.9	427597	17974	7612	1781	8580	0.48	0.46	0.45	0.57	0.71	1.12
RULE B	a	1	418879	-14507	-15353	-53	899	0.52	0.50	0.49	0.51	0.62	0.98
RULE B	b	0.1	284521	322834	238078	14727	70029	0.01	0.04	0.02	1.14	1.13	2.04
RULE B	b	0.2	391332	301319	210013	15287	76020	0.02	0.03	0.02	1.06	1.15	2.11
RULE B	b	0.3	448528	268379	180244	14794	73341	0.04	0.04	0.03	0.99	1.14	2.09
RULE B	b	0.4	479605	235582	154887	13653	67043	0.07	0.06	0.05	0.92	1.10	2.00
RULE B	b	0.5	493920	211671	137030	12586	62056	0.10	0.10	0.08	0.88	1.07	1.91
RULE B	b	0.6	503646	196199	127034	11761	57404	0.14	0.14	0.11	0.85	1.04	1.85
RULE B	b	0.7	507726	187676	120717	11273	55686	0.16	0.18	0.14	0.84	1.02	1.83
RULE B	b	0.8	508725	175112	112066	10777	52268	0.19	0.20	0.15	0.82	1.01	1.80
RULE B	b	0.9	510683	170730	109231	10671	50828	0.20	0.21	0.15	0.81	1.00	1.76
RULE B	b	1	510393	161652	103013	10181	48459	0.21	0.22	0.17	0.80	0.99	1.72
RULE B	c	0.1	358113	344319	249452	15389	79478	0.01	0.03	0.01	1.17	1.16	2.17
RULE B	c	0.2	406801	298305	206770	15086	76449	0.02	0.03	0.01	1.06	1.14	2.12
RULE B	c	0.3	452989	245722	161489	14033	70199	0.07	0.06	0.05	0.94	1.10	2.03
RULE B	c	0.4	468498	190476	120852	12314	57311	0.14	0.12	0.12	0.84	1.05	1.85
RULE B	c	0.5	473584	139009	86891	9775	42344	0.24	0.22	0.22	0.75	0.97	1.63
RULE B	c	0.6	477228	97130	60786	7550	28793	0.32	0.31	0.30	0.69	0.89	1.42
RULE B	c	0.7	470578	54775	33409	4366	17010	0.41	0.40	0.38	0.63	0.78	1.22
RULE B	c	0.8	464118	18160	8592	1347	8220	0.48	0.47	0.44	0.57	0.69	1.09
RULE B	c	0.9	451972	-12437	-13522	-711	1796	0.53	0.51	0.49	0.52	0.60	0.99
RULE B	c	1	442167	-50239	-40572	-3235	-6432	0.58	0.56	0.55	0.43	0.47	0.87
RULE B	d	0.1	358165	344709	249991	15962	78756	0.01	0.03	0.01	1.17	1.17	2.16
RULE B	d	0.2	415598	311629	215907	15518	80204	0.02	0.03	0.01	1.08	1.16	2.18
RULE B	d	0.3	466829	266965	175307	14965	75693	0.04	0.04	0.02	0.98	1.14	2.11
RULE B	d	0.4	489406	233063	150151	13748	69164	0.07	0.07	0.05	0.92	1.09	2.02
RULE B	d	0.5	502289	207520	132306	12479	62735	0.11	0.10	0.09	0.86	1.06	1.93
RULE B	d	0.6	508863	188078	118866	11759	57452	0.15	0.15	0.12	0.83	1.03	1.85
RULE B	d	0.7	512477	178426	111708	11212	55506	0.17	0.18	0.14	0.82	1.02	1.82
RULE B	d	0.8	514629	162240	101875	10211	50154	0.21	0.21	0.16	0.79	0.99	1.75
RULE B	d	0.9	513548	160525	100086	10164	50275	0.21	0.23	0.17	0.79	0.98	1.75
RULE B	d	1	515394	151504	94429	9771	47303	0.23	0.24	0.19	0.78	0.97	1.70

80% Spain, 10% France

HCR	Case	Gamma	GR anchovy	Cash Flow Overall	Cash_SP_PS	Cash_FR_PS	Cash_FR_PL	Prob_cash<0_SP_PS	Prob_cash<0_FR_PS	Prob_cash<0_FR_PL	SocInd_SP_PS	SocInd_FR_PS	SocInd_FR_PL
RULE A	a	0.1	234223	319511	228002	15313	76195	0.02	0.03	0.01	1.12	1.15	2.13
RULE A	a	0.2	331104	308489	214579	15597	78313	0.02	0.03	0.01	1.08	1.16	2.15
RULE A	a	0.3	375799	286971	196932	15216	75823	0.04	0.03	0.02	1.03	1.14	2.12
RULE A	a	0.4	396337	260249	175088	14229	70932	0.07	0.05	0.04	0.98	1.12	2.04
RULE A	a	0.5	409727	233473	154768	13349	66356	0.11	0.08	0.08	0.93	1.09	1.96
RULE A	a	0.6	404273	216893	143169	12565	61158	0.14	0.11	0.11	0.90	1.06	1.90
RULE A	a	0.7	410515	197027	128866	11790	56370	0.19	0.15	0.15	0.86	1.04	1.83
RULE A	a	0.8	408167	186947	121833	11480	53635	0.20	0.17	0.16	0.84	1.03	1.80
RULE A	a	0.9	411374	166068	104803	10884	50381	0.24	0.20	0.20	0.80	1.01	1.75
RULE A	a	1	409780	150432	95265	10198	44969	0.27	0.24	0.23	0.78	0.98	1.68
RULE A	b	0.1	238585	321930	230186	15382	76362	0.02	0.03	0.01	1.12	1.15	2.13
RULE A	b	0.2	335449	315856	219565	15600	80691	0.02	0.03	0.01	1.09	1.16	2.19
RULE A	b	0.3	399611	296239	203306	15210	77723	0.02	0.03	0.01	1.05	1.15	2.15
RULE A	b	0.4	436779	275645	185809	14894	74943	0.04	0.03	0.02	1.00	1.14	2.11
RULE A	b	0.5	460974	259025	171880	14481	72663	0.05	0.05	0.03	0.97	1.12	2.07
RULE A	b	0.6	472908	245105	161631	14168	69306	0.06	0.06	0.05	0.94	1.11	2.03
RULE A	b	0.7	479808	228581	147651	13708	67222	0.08	0.07	0.06	0.91	1.10	1.99
RULE A	b	0.8	482978	218944	140987	13020	64937	0.11	0.09	0.08	0.89	1.08	1.95
RULE A	b	0.9	489814	211042	134459	13029	63554	0.12	0.10	0.09	0.87	1.07	1.94
RULE A	b	1	492960	201701	128388	12442	60871	0.13	0.12	0.10	0.86	1.06	1.91
RULE A	c	0.1	363812	356975	250304	16481	90189	0.01	0.02	0.00	1.17	1.19	2.33
RULE A	c	0.2	408624	321219	219608	16295	85317	0.02	0.02	0.00	1.10	1.18	2.26
RULE A	c	0.3	434561	285688	191153	15139	79396	0.04	0.03	0.02	1.02	1.15	2.17
RULE A	c	0.4	442744	250452	163450	14364	72638	0.08	0.05	0.05	0.95	1.12	2.05
RULE A	c	0.5	445733	219910	139909	13115	66886	0.13	0.09	0.09	0.89	1.08	1.97
RULE A	c	0.6	448683	196110	123255	12303	60552	0.17	0.13	0.13	0.84	1.05	1.88
RULE A	c	0.7	445662	171115	105827	11361	53928	0.21	0.17	0.17	0.80	1.02	1.80
RULE A	c	0.8	446961	156361	96586	10669	49106	0.25	0.20	0.21	0.77	1.00	1.73
RULE A	c	0.9	445201	134353	80773	9723	43856	0.29	0.24	0.25	0.74	0.97	1.67
RULE A	c	1	443834	110887	64808	8714	37366	0.33	0.27	0.27	0.71	0.94	1.54
RULE A	d	0.1	362839	355704	249130	16597	89977	0.01	0.02	0.00	1.18	1.20	2.33
RULE A	d	0.2	414683	329971	225807	16240	87925	0.01	0.02	0.00	1.11	1.19	2.28
RULE A	d	0.3	450601	300990	201316	15912	83762	0.02	0.02	0.01	1.05	1.17	2.23
RULE A	d	0.4	468436	280120	184841	15275	80004	0.03	0.03	0.01	1.00	1.15	2.18
RULE A	d	0.5	479372	259582	169001	14714	75867	0.05	0.05	0.03	0.96	1.14	2.11
RULE A	d	0.6	488656	244451	157288	14177	72986	0.06	0.05	0.04	0.93	1.12	2.07
RULE A	d	0.7	493206	229844	146807	13700	69336	0.08	0.07	0.06	0.91	1.10	2.03
RULE A	d	0.8	496100	221748	139959	13720	68069	0.09	0.08	0.07	0.89	1.09	2.01
RULE A	d	0.9	498979	209815	132283	12880	64652	0.11	0.10	0.08	0.86	1.07	1.96
RULE A	d	1	502122	201269	125253	12460	63555	0.13	0.11	0.10	0.85	1.06	1.94
RULE B	a	0.1	287297	326062	229631	15461	80969	0.02	0.03	0.01	1.12	1.16	2.20
RULE B	a	0.2	391370	301891	206325	15467	80099	0.02	0.03	0.01	1.06	1.15	2.17
RULE B	a	0.3	435599	251299	166011	14242	71047	0.06	0.05	0.04	0.96	1.11	2.04
RULE B	a	0.4	454314	202075	129899	12677	59499	0.13	0.10	0.10	0.86	1.06	1.88
RULE B	a	0.5	463044	161824	102047	10926	48851	0.22	0.17	0.18	0.79	1.01	1.75
RULE B	a	0.6	459014	126406	77568	9294	39544	0.29	0.25	0.24	0.73	0.95	1.60
RULE B	a	0.7	453441	97133	59947	7693	29492	0.35	0.31	0.30	0.69	0.90	1.44
RULE B	a	0.8	443036	49679	23491	5482	20706	0.44	0.38	0.37	0.61	0.83	1.26
RULE B	a	0.9	434173	26696	9690	3316	13691	0.48	0.43	0.41	0.57	0.76	1.17
RULE B	a	1	422402	-4170	-14273	1389	8714	0.52	0.47	0.44	0.52	0.71	1.07
RULE B	b	0.1	289473	329203	233383	15784	80037	0.02	0.03	0.01	1.13	1.17	2.19
RULE B	b	0.2	397913	307469	210346	15647	81475	0.02	0.03	0.01	1.07	1.17	2.20
RULE B	b	0.3	453506	268167	177402	14957	75808	0.04	0.04	0.02	0.99	1.14	2.11
RULE B	b	0.4	479248	232421	150221	13760	68440	0.07	0.06	0.06	0.91	1.10	2.02
RULE B	b	0.5	494608	214137	136304	12964	64869	0.11	0.10	0.09	0.88	1.08	1.95
RULE B	b	0.6	500257	196623	123733	12439	60451	0.14	0.13	0.11	0.85	1.06	1.91
RULE B	b	0.7	505323	183926	115057	11723	57145	0.16	0.15	0.13	0.82	1.03	1.85
RULE B	b	0.8	505979	172551	106786	11461	54304	0.19	0.18	0.15	0.81	1.02	1.81
RULE B	b	0.9	506167	167362	103551	10935	52876	0.21	0.19	0.17	0.79	1.01	1.80
RULE B	b	1	508082	163596	100371	10884	52341	0.21	0.19	0.17	0.79	1.01	1.78
RULE B	c	0.1	361238	349535	243743	16526	89266	0.01	0.02	0.00	1.15	1.19	2.32
RULE B	c	0.2	415999	303777	205351	15679	82746	0.02	0.03	0.01	1.05	1.16	2.21
RULE B	c	0.3	450120	247616	161260	14143	72213	0.07	0.05	0.04	0.95	1.11	2.06
RULE B	c	0.4	468568	191520	120153	12433	58934	0.15	0.11	0.11	0.83	1.05	1.88
RULE B	c	0.5	477455	142090	84773	10313	47003	0.24	0.19	0.20	0.74	0.99	1.70
RULE B	c	0.6	473651	96458	55547	8194	32717	0.34	0.28	0.28	0.68	0.92	1.46
RULE B	c	0.7	469126	61799	33520	5786	22492	0.41	0.36	0.34	0.63	0.84	1.29
RULE B	c	0.8	464162	22312	6145	3375	12791	0.48	0.42	0.40	0.57	0.76	1.14
RULE B	c	0.9	449328	-13312	-19196	731	5154	0.54	0.48	0.46	0.49	0.67	1.04
RULE B	c	1	441098	-45633	-42837	-1244	-1552	0.59	0.53	0.51	0.44	0.57	0.94
RULE B	d	0.1	363853	352620	247424	16649	88547	0.01	0.02	0.00	1.16	1.20	2.31
RULE B	d	0.2	418029	308289	208196	15645	84448	0.02	0.03	0.01	1.06	1.16	2.24
RULE B	d	0.3	466529	267451	175374	15026	77051	0.04	0.03	0.02	0.98	1.14	2.13
RULE B	d	0.4	488946	232644	148409	13804	70431	0.07	0.06	0.05	0.91	1.11	2.03
RULE B	d	0.5	500237	205357	127827	12895	64635	0.11	0.09	0.09	0.86	1.07	1.97
RULE B	d	0.6	505941	186242	113597	12113	60531	0.15	0.13	0.12	0.82	1.05	1.90
RULE B	d	0.7	509633	174205	106868	11382	55965	0.19	0.16	0.14	0.80	1.03	1.86
RULE B	d	0.8	510234	165398	100452	10974	53971	0.21	0.19	0.16	0.79	1.01	1.81
RULE B	d	0.9	510555	162157	98678	10585	52894	0.22	0.20	0.17	0.78	1.00	1.80
RULE B	d	1	511786	151322	90732	10427	50163	0.23	0.21	0.18	0.77	0.99	1.74

70% Spain, 30% France

HCR	Case	Gamma	GR_an	Cash	oash_SP_PS	oash_FR_PS	oash_FR_PL	Prob_oash0_SP_PS	Prob_oash0_FR_PS	Prob_oash0_FR_PL	SocInd_SP_PS	SocInd_SI_FR_PS	SocInd_FR_PL
RULE A	a	0.1	233720	319760	228462	15367	75941	0.02	0.04	0.01	1.12	1.16	2.12
RULE A	a	0.2	325580	311037	216769	15371	78898	0.02	0.03	0.01	1.08	1.15	2.16
RULE A	a	0.3	374876	284947	194257	15038	75653	0.04	0.03	0.02	1.03	1.15	2.11
RULE A	a	0.4	394966	259425	174401	14240	70784	0.07	0.05	0.04	0.98	1.12	2.04
RULE A	a	0.5	401862	237176	157887	13323	65966	0.11	0.08	0.07	0.94	1.09	1.97
RULE A	a	0.6	413815	214851	141410	12856	60595	0.14	0.11	0.11	0.89	1.06	1.90
RULE A	a	0.7	407606	195297	126665	11852	56779	0.18	0.15	0.14	0.86	1.04	1.85
RULE A	a	0.8	410400	182018	118027	11323	52668	0.21	0.17	0.18	0.83	1.02	1.79
RULE A	a	0.9	413379	163838	103229	10587	50021	0.25	0.20	0.20	0.80	1.00	1.74
RULE A	a	1	410847	147143	92609	9901	44633	0.28	0.24	0.23	0.78	0.97	1.67
RULE A	b	0.1	233079	323475	231225	15420	76830	0.02	0.03	0.01	1.12	1.16	2.13
RULE A	b	0.2	332862	317244	220585	15552	81107	0.02	0.03	0.01	1.10	1.17	2.19
RULE A	b	0.3	392342	298233	203987	15580	78666	0.03	0.03	0.01	1.05	1.16	2.16
RULE A	b	0.4	428489	277327	186401	15025	75901	0.03	0.03	0.01	1.01	1.15	2.11
RULE A	b	0.5	454946	261952	173297	14711	73944	0.04	0.04	0.03	0.98	1.13	2.08
RULE A	b	0.6	468735	248468	163816	14324	70328	0.05	0.05	0.04	0.95	1.12	2.04
RULE A	b	0.7	478004	242099	158652	13756	69691	0.07	0.06	0.06	0.93	1.10	2.02
RULE A	b	0.8	485494	229118	148984	13415	66719	0.08	0.07	0.06	0.90	1.09	1.99
RULE A	b	0.9	489503	215988	138246	13276	64465	0.10	0.09	0.08	0.89	1.08	1.95
RULE A	b	1	492260	205275	130337	12773	62166	0.12	0.10	0.09	0.87	1.07	1.92
RULE A	c	0.1	360215	357176	248743	16735	91698	0.01	0.02	0.00	1.17	1.20	2.33
RULE A	c	0.2	409035	323311	220516	16356	86439	0.02	0.02	0.01	1.10	1.18	2.26
RULE A	c	0.3	433378	281726	187871	15052	78803	0.04	0.03	0.02	1.01	1.14	2.16
RULE A	c	0.4	441423	256587	169845	14481	72261	0.08	0.05	0.05	0.96	1.11	2.07
RULE A	c	0.5	445109	219718	139744	13486	66488	0.13	0.09	0.09	0.89	1.09	1.98
RULE A	c	0.6	450559	193139	121807	12291	59041	0.17	0.13	0.13	0.84	1.05	1.88
RULE A	c	0.7	446715	175243	108860	11227	55157	0.21	0.18	0.17	0.82	1.02	1.82
RULE A	c	0.8	449526	147907	89469	10536	47902	0.26	0.21	0.22	0.77	0.99	1.72
RULE A	c	0.9	445266	136428	83385	9616	43427	0.29	0.24	0.24	0.74	0.96	1.65
RULE A	c	1	445538	113347	68067	8725	36555	0.33	0.28	0.28	0.71	0.94	1.54
RULE A	d	0.1	364202	354873	247837	16708	90328	0.01	0.03	0.00	1.16	1.21	2.32
RULE A	d	0.2	419972	331427	227444	16062	87920	0.01	0.02	0.00	1.11	1.18	2.30
RULE A	d	0.3	450674	303364	204483	15663	83218	0.02	0.02	0.00	1.05	1.17	2.23
RULE A	d	0.4	466559	281243	186076	15227	79940	0.03	0.03	0.01	1.00	1.15	2.16
RULE A	d	0.5	482185	262860	171675	14696	76489	0.04	0.04	0.03	0.96	1.13	2.12
RULE A	d	0.6	488414	243948	157200	14272	72476	0.06	0.05	0.04	0.93	1.11	2.07
RULE A	d	0.7	492860	231782	148570	13810	69402	0.07	0.07	0.05	0.91	1.10	2.03
RULE A	d	0.8	495905	221275	139091	13398	68786	0.09	0.08	0.07	0.88	1.09	2.00
RULE A	d	0.9	498940	211245	131920	12838	66487	0.11	0.10	0.09	0.87	1.07	1.98
RULE A	d	1	500510	201758	125158	12992	63609	0.12	0.11	0.09	0.85	1.07	1.94
RULE B	a	0.1	290616	329258	232710	15816	80733	0.02	0.03	0.01	1.13	1.17	2.18
RULE B	a	0.2	389589	298713	203445	15462	79806	0.02	0.03	0.01	1.05	1.15	2.17
RULE B	a	0.3	435216	260403	165312	14207	70884	0.06	0.04	0.04	0.96	1.12	2.04
RULE B	a	0.4	454631	207222	134160	12633	60429	0.13	0.10	0.10	0.87	1.06	1.89
RULE B	a	0.5	463690	161509	101087	11135	49287	0.22	0.17	0.17	0.79	1.01	1.73
RULE B	a	0.6	461853	125623	76255	9329	40040	0.30	0.25	0.25	0.73	0.96	1.59
RULE B	a	0.7	454934	87634	51556	7219	28859	0.37	0.32	0.30	0.67	0.89	1.42
RULE B	a	0.8	444310	56116	30553	5273	20290	0.43	0.38	0.36	0.62	0.83	1.28
RULE B	a	0.9	435275	29567	11079	3989	14499	0.48	0.41	0.41	0.58	0.78	1.17
RULE B	a	1	425276	-16085	-21641	934	4622	0.54	0.48	0.47	0.49	0.67	1.01
RULE B	b	0.1	288459	324329	228895	15663	79780	0.02	0.03	0.01	1.12	1.16	2.18
RULE B	b	0.2	396719	306954	209578	15524	81852	0.02	0.03	0.01	1.06	1.16	2.20
RULE B	b	0.3	453676	269372	178235	14849	76289	0.04	0.03	0.02	0.99	1.14	2.12
RULE B	b	0.4	480680	237152	152880	14101	70171	0.07	0.06	0.05	0.92	1.11	2.03
RULE B	b	0.5	492951	212933	135499	13130	64304	0.10	0.09	0.09	0.87	1.08	1.94
RULE B	b	0.6	500755	195800	123316	12491	59993	0.13	0.12	0.11	0.84	1.06	1.89
RULE B	b	0.7	504326	179310	111987	11711	55612	0.17	0.16	0.13	0.82	1.03	1.82
RULE B	b	0.8	505523	176772	110300	11327	55145	0.19	0.17	0.15	0.81	1.03	1.83
RULE B	b	0.9	508094	163422	99444	10967	53011	0.21	0.20	0.17	0.79	1.01	1.79
RULE B	b	1	508765	155149	102627	10922	51600	0.21	0.20	0.16	0.79	1.01	1.78
RULE B	c	0.1	363134	347520	242157	16283	89081	0.01	0.02	0.00	1.15	1.19	2.31
RULE B	c	0.2	417540	299856	202048	15617	82191	0.02	0.02	0.01	1.05	1.16	2.21
RULE B	c	0.3	451363	249543	162242	14278	73023	0.07	0.05	0.04	0.94	1.12	2.06
RULE B	c	0.4	468089	195043	121647	12619	60778	0.14	0.10	0.11	0.84	1.06	1.91
RULE B	c	0.5	474695	145208	86795	10494	47920	0.24	0.19	0.19	0.75	0.99	1.70
RULE B	c	0.6	474428	98432	56672	8325	33435	0.34	0.29	0.27	0.68	0.92	1.48
RULE B	c	0.7	470059	51943	26572	5327	20043	0.43	0.37	0.35	0.61	0.83	1.26
RULE B	c	0.8	462004	21363	4816	3447	13100	0.49	0.42	0.41	0.57	0.77	1.15
RULE B	c	0.9	454785	-5686	-12586	1623	5277	0.53	0.47	0.46	0.51	0.69	1.05
RULE B	c	1	446498	-42191	-39803	-1221	-1167	0.59	0.52	0.51	0.42	0.56	0.95
RULE B	d	0.1	365101	352771	246636	16724	89411	0.01	0.02	0.00	1.16	1.19	2.31
RULE B	d	0.2	418652	309508	210190	16028	83291	0.02	0.02	0.01	1.07	1.18	2.22
RULE B	d	0.3	467009	270122	176832	15174	78116	0.04	0.03	0.02	0.98	1.14	2.15
RULE B	d	0.4	487854	230362	146568	13891	69903	0.07	0.06	0.06	0.90	1.10	2.04
RULE B	d	0.5	500836	208842	131233	13091	64518	0.11	0.10	0.09	0.87	1.08	1.95
RULE B	d	0.6	506137	190549	118033	12218	60298	0.14	0.13	0.11	0.83	1.05	1.90
RULE B	d	0.7	509379	178266	109860	11399	57007	0.18	0.16	0.14	0.81	1.03	1.85
RULE B	d	0.8	509883	168871	102906	11083	54882	0.19	0.18	0.15	0.79	1.02	1.82
RULE B	d	0.9	511073	158017	95544	10804	51669	0.22	0.20	0.17	0.78	1.01	1.77
RULE B	d	1	511692	157276	94927	10542	51807	0.23	0.21	0.17	0.78	1.00	1.77

60% Spain, 40% France

HCR	Case	Gamma	GR_an	Cash	oach_SP_PS	oach_FR_PS	oach_FR_PL	Prob_oach0_SP_PS	Prob_oach0_FR_PS	Prob_oach0_FR_PL	SocInd_SP_PS	SocInd_SI_FR_PS	SocInd_FR_PL
RULE A	a	0.1	235177	322870	224318	15884	82668	0.02	0.03	0.01	1.10	1.18	2.22
RULE A	a	0.2	329386	316299	215477	16020	84802	0.02	0.03	0.01	1.08	1.17	2.26
RULE A	a	0.3	380642	291823	195876	15186	80760	0.04	0.03	0.03	1.03	1.15	2.18
RULE A	a	0.4	393231	264818	177661	14378	72779	0.07	0.06	0.06	0.98	1.12	2.07
RULE A	a	0.5	405493	242120	161659	13277	67183	0.10	0.10	0.10	0.94	1.09	1.99
RULE A	a	0.6	406557	221014	146803	12450	61761	0.14	0.14	0.13	0.91	1.05	1.92
RULE A	a	0.7	408794	197499	129723	11387	56389	0.18	0.19	0.18	0.87	1.02	1.84
RULE A	a	0.8	404025	184359	121980	10672	51707	0.20	0.21	0.20	0.85	1.00	1.78
RULE A	a	0.9	409411	160181	104388	9612	46181	0.25	0.25	0.24	0.81	0.97	1.70
RULE A	a	1	409102	141639	92300	8552	40788	0.28	0.29	0.26	0.77	0.94	1.61
RULE A	b	0.1	235610	326805	226481	16066	84258	0.02	0.03	0.01	1.11	1.18	2.23
RULE A	b	0.2	333069	320934	218820	16221	85894	0.02	0.03	0.01	1.08	1.18	2.27
RULE A	b	0.3	398575	304931	205121	15753	84058	0.02	0.02	0.01	1.06	1.17	2.24
RULE A	b	0.4	432359	289866	194275	15022	80568	0.03	0.04	0.02	1.02	1.14	2.18
RULE A	b	0.5	455116	272394	181238	14536	76621	0.04	0.04	0.03	0.99	1.12	2.12
RULE A	b	0.6	473015	257798	170236	13962	73580	0.06	0.06	0.04	0.97	1.11	2.08
RULE A	b	0.7	481445	242814	158997	13606	70211	0.07	0.07	0.05	0.94	1.09	2.04
RULE A	b	0.8	487896	237156	156614	13227	67315	0.08	0.09	0.07	0.93	1.08	1.99
RULE A	b	0.9	492060	226013	148022	12671	65321	0.10	0.11	0.08	0.91	1.06	1.97
RULE A	b	1	493878	218390	142371	12439	63580	0.11	0.12	0.09	0.90	1.05	1.94
RULE A	c	0.1	364342	357137	241792	17367	97979	0.01	0.02	0.00	1.15	1.22	2.46
RULE A	c	0.2	414038	327950	217793	16392	93764	0.02	0.02	0.01	1.09	1.19	2.37
RULE A	c	0.3	432418	292291	193309	15260	83722	0.04	0.04	0.03	1.03	1.15	2.24
RULE A	c	0.4	444368	257755	170219	13797	73738	0.08	0.08	0.08	0.96	1.10	2.08
RULE A	c	0.5	446738	225069	146058	12760	66251	0.12	0.12	0.12	0.91	1.07	1.99
RULE A	c	0.6	447386	200614	130908	11480	58227	0.17	0.17	0.16	0.86	1.03	1.87
RULE A	c	0.7	451613	174157	113158	10215	50784	0.22	0.22	0.22	0.82	0.99	1.76
RULE A	c	0.8	445727	150770	100284	8961	41525	0.26	0.26	0.26	0.79	0.95	1.63
RULE A	c	0.9	444138	125879	81763	7861	36265	0.29	0.30	0.29	0.74	0.91	1.52
RULE A	c	1	444287	102362	66142	7039	29181	0.34	0.35	0.32	0.71	0.87	1.41
RULE A	d	0.1	369235	364683	245076	17442	102166	0.01	0.02	0.00	1.16	1.22	2.50
RULE A	d	0.2	413633	338804	226643	16964	96197	0.01	0.02	0.00	1.11	1.20	2.40
RULE A	d	0.3	450427	310047	204345	15970	89732	0.02	0.02	0.01	1.05	1.17	2.31
RULE A	d	0.4	472561	288459	189106	15335	84018	0.03	0.03	0.02	1.01	1.15	2.23
RULE A	d	0.5	484891	271503	177404	14729	79370	0.04	0.05	0.03	0.98	1.13	2.17
RULE A	d	0.6	492543	248296	160656	13760	73880	0.06	0.07	0.04	0.95	1.11	2.10
RULE A	d	0.7	496168	239049	154862	13632	70655	0.07	0.08	0.06	0.93	1.09	2.05
RULE A	d	0.8	499463	223840	143997	12751	67092	0.09	0.11	0.08	0.90	1.06	1.99
RULE A	d	0.9	501086	215186	138179	12374	64633	0.11	0.12	0.09	0.88	1.05	1.95
RULE A	d	1	503190	210637	134930	12167	63540	0.12	0.13	0.10	0.87	1.04	1.95
RULE B	a	0.1	290852	332349	228304	16359	87685	0.02	0.02	0.00	1.11	1.19	2.29
RULE B	a	0.2	393233	306408	204951	15907	85550	0.02	0.03	0.01	1.06	1.17	2.25
RULE B	a	0.3	434685	255658	168424	13920	73315	0.07	0.06	0.06	0.97	1.10	2.08
RULE B	a	0.4	455906	207196	135944	11986	59266	0.13	0.13	0.12	0.88	1.04	1.88
RULE B	a	0.5	465358	164721	107851	9950	46920	0.20	0.21	0.19	0.81	0.98	1.68
RULE B	a	0.6	462678	121581	79758	7669	34154	0.28	0.30	0.27	0.74	0.90	1.48
RULE B	a	0.7	456534	84874	55251	5420	24203	0.36	0.37	0.34	0.69	0.83	1.32
RULE B	a	0.8	439891	47086	30052	2958	14076	0.42	0.44	0.41	0.62	0.74	1.17
RULE B	a	0.9	433143	24300	14605	1202	8493	0.47	0.47	0.44	0.59	0.68	1.08
RULE B	a	1	417822	-10801	-9571	-1519	289	0.52	0.52	0.50	0.53	0.57	0.98
RULE B	b	0.1	289524	327467	223941	16123	87402	0.02	0.03	0.01	1.11	1.18	2.29
RULE B	b	0.2	395331	311577	208335	16119	87123	0.02	0.02	0.01	1.06	1.17	2.28
RULE B	b	0.3	454448	278003	184644	14819	78540	0.04	0.04	0.02	1.00	1.13	2.16
RULE B	b	0.4	481253	242000	158054	13600	70346	0.07	0.07	0.05	0.94	1.09	2.04
RULE B	b	0.5	495396	218839	141671	12812	64357	0.10	0.11	0.08	0.90	1.06	1.96
RULE B	b	0.6	503462	198197	127197	11655	59346	0.14	0.16	0.11	0.86	1.03	1.87
RULE B	b	0.7	508014	186157	120787	10699	54671	0.16	0.19	0.13	0.84	1.00	1.81
RULE B	b	0.8	509685	176846	114831	10284	51731	0.18	0.21	0.15	0.82	0.99	1.78
RULE B	b	0.9	510949	175070	112280	10384	52406	0.19	0.22	0.15	0.82	0.99	1.77
RULE B	b	1	510384	170069	109190	10087	50792	0.20	0.23	0.16	0.81	0.98	1.74
RULE B	c	0.1	364067	352385	238170	17310	96905	0.01	0.02	0.00	1.14	1.23	2.42
RULE B	c	0.2	416907	309054	205636	15906	87511	0.02	0.03	0.01	1.05	1.18	2.28
RULE B	c	0.3	453763	255583	168291	13843	73448	0.07	0.06	0.06	0.96	1.10	2.09
RULE B	c	0.4	471226	195019	125771	11893	57356	0.14	0.14	0.13	0.86	1.03	1.87
RULE B	c	0.5	476838	143949	93668	9281	41000	0.23	0.25	0.23	0.77	0.95	1.60
RULE B	c	0.6	477234	96887	64171	6308	26408	0.32	0.34	0.31	0.69	0.86	1.37
RULE B	c	0.7	470753	57922	37981	3900	16041	0.40	0.42	0.38	0.64	0.77	1.20
RULE B	c	0.8	462189	20440	12420	725	7295	0.47	0.48	0.44	0.58	0.67	1.07
RULE B	c	0.9	460901	-20724	-16069	-2451	-2204	0.53	0.55	0.52	0.51	0.51	0.94
RULE B	c	1	445145	-57134	-43910	-4564	-8660	0.59	0.60	0.57	0.43	0.41	0.84
RULE B	d	0.1	366527	352797	238481	17028	97289	0.01	0.02	0.00	1.14	1.21	2.44
RULE B	d	0.2	422215	316870	210617	16216	90037	0.02	0.02	0.00	1.07	1.18	2.32
RULE B	d	0.3	469349	280119	183700	14932	81486	0.04	0.04	0.02	1.00	1.14	2.20
RULE B	d	0.4	491202	238989	153963	13513	71513	0.07	0.07	0.06	0.92	1.09	2.06
RULE B	d	0.5	503833	218596	139990	12293	66313	0.10	0.12	0.08	0.89	1.05	1.98
RULE B	d	0.6	508492	189031	121859	11111	56061	0.15	0.18	0.13	0.84	1.01	1.84
RULE B	d	0.7	512489	177141	112981	10479	53681	0.18	0.20	0.15	0.82	1.00	1.80
RULE B	d	0.8	514444	170577	109343	10106	51127	0.19	0.22	0.16	0.81	0.98	1.74
RULE B	d	0.9	514948	162639	103719	9796	49124	0.21	0.24	0.17	0.80	0.97	1.71
RULE B	d	1	516375	161946	104231	9582	48133	0.21	0.24	0.17	0.80	0.97	1.71

50% Spain, 50% France

HCR	Case	Gamma	GR_an	Cash	oach_SP_PS	oach_FR_PS	oach_FR_PL	Prob_oach0_SP_PS	Prob_oach0_FR_PS	Prob_oach0_FR_PL	Socind_SP_PS	Socind_SI_FR_PS	Socind_FR_PL
RULE A	a	0.1	231730	328315	223108	16285	88923	0.03	0.02	0.01	1.10	1.20	2.32
RULE A	a	0.2	327765	317322	212167	16064	89091	0.02	0.03	0.01	1.07	1.18	2.31
RULE A	a	0.3	372467	297939	198681	15097	84161	0.04	0.05	0.04	1.04	1.14	2.24
RULE A	a	0.4	390091	265968	178543	13822	73603	0.07	0.09	0.08	0.99	1.10	2.11
RULE A	a	0.5	396554	245771	164563	12882	68326	0.10	0.14	0.12	0.95	1.08	2.01
RULE A	a	0.6	405975	225171	151866	11598	61707	0.13	0.18	0.15	0.92	1.03	1.93
RULE A	a	0.7	400786	204374	138508	10578	56288	0.17	0.22	0.19	0.89	1.01	1.81
RULE A	a	0.8	398000	183327	125246	9661	48420	0.20	0.25	0.22	0.86	0.97	1.72
RULE A	a	0.9	396389	164475	111284	8486	44705	0.24	0.30	0.26	0.82	0.93	1.66
RULE A	a	1	396672	149825	102985	7999	38840	0.27	0.33	0.29	0.79	0.92	1.57
RULE A	b	0.1	234808	326613	220917	16488	89208	0.03	0.02	0.01	1.09	1.19	2.32
RULE A	b	0.2	332296	326474	218029	16500	91944	0.02	0.02	0.01	1.09	1.19	2.36
RULE A	b	0.3	391656	306826	204124	15780	86921	0.03	0.03	0.01	1.05	1.17	2.29
RULE A	b	0.4	427697	293333	195815	15156	82362	0.03	0.03	0.02	1.03	1.14	2.21
RULE A	b	0.5	451152	276957	184314	14230	78413	0.04	0.06	0.03	1.00	1.12	2.15
RULE A	b	0.6	463571	259852	172222	13440	74190	0.05	0.08	0.04	0.98	1.09	2.09
RULE A	b	0.7	471645	253117	168778	13191	71149	0.06	0.09	0.06	0.96	1.08	2.05
RULE A	b	0.8	479330	239829	159871	12350	67607	0.08	0.12	0.07	0.94	1.06	1.99
RULE A	b	0.9	485759	230349	153909	12117	64323	0.09	0.14	0.08	0.93	1.05	1.95
RULE A	b	1	488782	224294	149886	11705	62704	0.10	0.15	0.09	0.91	1.04	1.92
RULE A	c	0.1	364919	364791	239659	17654	107479	0.01	0.01	0.00	1.14	1.24	2.58
RULE A	c	0.2	407694	335222	218482	16846	99894	0.02	0.02	0.01	1.09	1.20	2.45
RULE A	c	0.3	430891	296734	193867	15452	87416	0.04	0.05	0.05	1.03	1.15	2.29
RULE A	c	0.4	439375	264824	173093	13557	78175	0.07	0.11	0.09	0.97	1.10	2.16
RULE A	c	0.5	440782	235032	156632	12049	66352	0.12	0.16	0.15	0.93	1.04	1.98
RULE A	c	0.6	443847	201568	133605	10645	57318	0.15	0.22	0.19	0.88	1.00	1.85
RULE A	c	0.7	443181	176126	119761	9083	47282	0.21	0.27	0.24	0.84	0.95	1.69
RULE A	c	0.8	439614	143804	97717	7601	38487	0.26	0.33	0.29	0.79	0.89	1.53
RULE A	c	0.9	436063	126572	87758	6538	32276	0.29	0.35	0.32	0.76	0.87	1.45
RULE A	c	1	433187	102999	73871	4911	24217	0.33	0.40	0.36	0.73	0.81	1.34
RULE A	d	0.1	364137	363479	236914	18200	108365	0.02	0.01	0.00	1.14	1.25	2.60
RULE A	d	0.2	413181	344429	225786	17311	101332	0.01	0.01	0.00	1.11	1.22	2.49
RULE A	d	0.3	446886	316378	206823	16142	93414	0.02	0.02	0.01	1.06	1.18	2.37
RULE A	d	0.4	466540	292944	192389	14937	85618	0.03	0.04	0.02	1.02	1.14	2.27
RULE A	d	0.5	479889	275748	180854	14406	80488	0.04	0.06	0.03	0.99	1.12	2.20
RULE A	d	0.6	485418	256587	168736	13346	74505	0.06	0.09	0.05	0.96	1.09	2.10
RULE A	d	0.7	490858	245680	162349	12682	70649	0.07	0.11	0.06	0.95	1.06	2.05
RULE A	d	0.8	494047	239004	159076	12231	67698	0.09	0.12	0.07	0.94	1.05	2.00
RULE A	d	0.9	496565	228042	152126	11646	64270	0.09	0.15	0.09	0.92	1.03	1.94
RULE A	d	1	500809	219247	146483	11293	61471	0.11	0.16	0.09	0.91	1.02	1.90
RULE B	a	0.1	288105	333384	222910	16978	93496	0.02	0.02	0.01	1.10	1.21	2.39
RULE B	a	0.2	391617	314195	208221	15947	90027	0.02	0.02	0.01	1.06	1.17	2.32
RULE B	a	0.3	434732	264964	176243	13539	75182	0.06	0.08	0.06	0.98	1.10	2.10
RULE B	a	0.4	453029	210078	141215	11116	57748	0.12	0.17	0.14	0.89	1.01	1.85
RULE B	a	0.5	458285	165343	113951	8911	42481	0.20	0.27	0.22	0.82	0.94	1.62
RULE B	a	0.6	453883	121387	86547	5796	29043	0.28	0.37	0.30	0.76	0.84	1.40
RULE B	a	0.7	446875	85614	61451	3351	20812	0.34	0.43	0.36	0.70	0.76	1.29
RULE B	a	0.8	428329	52161	39844	510	11807	0.40	0.49	0.42	0.64	0.67	1.15
RULE B	a	0.9	411056	24567	21298	-1828	5097	0.46	0.53	0.46	0.60	0.56	1.04
RULE B	a	1	406145	-11361	-4776	-4838	-1747	0.50	0.58	0.50	0.54	0.43	0.96
RULE B	b	0.1	286400	332340	222253	16636	93451	0.02	0.02	0.00	1.10	1.20	2.38
RULE B	b	0.2	393811	314028	207292	16033	90702	0.02	0.02	0.01	1.06	1.18	2.34
RULE B	b	0.3	447844	282548	186929	14560	81059	0.04	0.04	0.02	1.01	1.13	2.19
RULE B	b	0.4	475854	246326	163217	13002	70108	0.06	0.09	0.06	0.94	1.07	2.03
RULE B	b	0.5	491069	225801	151251	11856	62694	0.09	0.14	0.08	0.92	1.03	1.93
RULE B	b	0.6	498073	203586	136903	10732	55951	0.13	0.19	0.11	0.88	1.00	1.82
RULE B	b	0.7	501786	195102	131909	10149	53045	0.15	0.22	0.13	0.87	0.98	1.76
RULE B	b	0.8	504734	189084	127508	9558	52017	0.17	0.24	0.13	0.86	0.97	1.75
RULE B	b	0.9	504043	184430	124774	9243	50412	0.18	0.25	0.15	0.85	0.96	1.73
RULE B	b	1	504829	172615	116996	8840	46780	0.19	0.27	0.16	0.83	0.94	1.68
RULE B	c	0.1	363636	356076	233138	17903	105036	0.01	0.01	0.00	1.12	1.24	2.55
RULE B	c	0.2	413678	316184	207981	16263	91541	0.02	0.03	0.01	1.06	1.18	2.36
RULE B	c	0.3	449471	263657	173700	13606	76350	0.06	0.08	0.07	0.98	1.09	2.12
RULE B	c	0.4	464205	204489	137371	10987	56130	0.13	0.19	0.16	0.89	1.00	1.83
RULE B	c	0.5	471965	149139	102815	7718	38606	0.21	0.31	0.24	0.80	0.91	1.54
RULE B	c	0.6	470574	95966	68738	4197	23032	0.31	0.41	0.33	0.71	0.78	1.30
RULE B	c	0.7	463712	56661	43985	314	12362	0.39	0.49	0.41	0.64	0.65	1.14
RULE B	c	0.8	455111	17462	15467	-2499	4494	0.46	0.55	0.46	0.59	0.52	1.05
RULE B	c	0.9	441093	-13398	-5183	-5737	-2478	0.51	0.60	0.52	0.54	0.40	0.95
RULE B	c	1	426116	-61883	-41823	-8440	-11620	0.58	0.66	0.58	0.44	0.29	0.84
RULE B	d	0.1	363992	358150	234149	17952	106048	0.02	0.01	0.00	1.13	1.24	2.55
RULE B	d	0.2	415730	325601	213561	16707	96333	0.02	0.02	0.00	1.08	1.20	2.40
RULE B	d	0.3	465107	288785	189924	14564	84297	0.03	0.05	0.02	1.02	1.13	2.24
RULE B	d	0.4	485903	245792	162212	12805	70775	0.06	0.09	0.06	0.95	1.07	2.05
RULE B	d	0.5	498679	217748	145026	11340	61381	0.10	0.15	0.09	0.91	1.02	1.91
RULE B	d	0.6	504584	201291	135590	10417	55283	0.14	0.20	0.11	0.88	0.99	1.81
RULE B	d	0.7	508598	186708	126735	9644	52329	0.15	0.23	0.12	0.86	0.97	1.76
RULE B	d	0.8	510274	181176	123431	9116	48629	0.17	0.25	0.15	0.85	0.96	1.71
RULE B	d	0.9	509735	167091	113615	8443	45034	0.19	0.28	0.16	0.83	0.93	1.64
RULE B	d	1	511373	164581	110740	8508	45333	0.21	0.28	0.17	0.81	0.92	1.64

10. Annex Expert declarations

Declarations of invited experts are published on the STECF web site on https://stecf.jrc.ec.europa.eu/home together with the final report.

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Abstract
SGBRE-08-01 was held on 2-6 June 2008 in San Sebastian (Spain). The meeting was focusing on the assessment of the impact of long-term management strategies of anchovy in the Bay of Biscay. STECF reviewed the report during its plenary meeting 7-11 July 2008.

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